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TEACHING LIBRARY USE TO UNDERGRADUATE--COMPARISON OF COMPUTER-BASED INSTRUCTION AND THE CONVENTIONAL LECTURE. FINAL REPORT.

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DESCRIPTORS- *LIBRARY INSTRUCTION, *COMPUTER ASSISTED INSTRUCTION, *PROGRAMED INSTRUCTION, UNDERGRADUATE STUDY, PLATO (PROGRAMMED LOGIC FOR AUTOMATIC OPERATIONS)

THE OVER-ALL OBJECTIVE OF THIS STUDY WAS TO PROVIDE SPECIFIC INFORMATION CONCERNING THE EFFECTIVENESS OF COMPUTER-BASED INSTRUCTION IN TEACHING THE USE OF THE LIBRARY. THE SIXTY-SIX STUDENTS WHO PARTICIPATED IN THIS THREE SEMESTER EXPERIMENT WERE UNDERGRADUATES ENROLLED IN LIBRARY SCIENCE 195, A COURSE OFFERED FOR CREDIT BY THE UNIVERSITY OF ILLINOIS GRADUATE SCHOOL OF LIBRARY SCIENCE. THE EXPERIMENTAL GROUP RECEIVED THEIR INSTRUCTION BY THE LECTURE METHOD. THE AUTHOR WROTE A 923-FRAME PROGRAM, EXCLUDING THE "HELP" SEQUENCES FOR THE PLATO TEACHING SYSTEM. THE FOLLOWING ARE SOME OF THE CONCLUSIONS DRAWN FROM THIS STUDY-- 1. STUDENTS UNDER BOTH TREATMENTS MADE SIGNIFICANT GAINS IN THEIR KNOWLEDGE OF LIBRARY USE, 2. THE EXPERIMENTAL AND CONTROL GROUPS DID NOT DIFFER SIGNIFICANTLY IN THE AMOUNT OF KNOWLEDGE GAINED AS A RESULT OF THEIR RESPECTIVE TREATMENTS, 3. IT WAS SEEN THAT IN CLASS THE EXPERIMENTAL GROUP COVERED THE SAME AMOUNT OF MATERIAL IN LESS TIME THAN THE CONTROL GROUPS, 4. MUCH MORE TIME WAS REQUIRED FOR THE INITIAL PREPARATION OF PLATO LESSONS THAN CONVENTIONAL LECTURES, 5. SUBSEQUENT PREPARATIONS FOR PLATO LESSONS REQUIRED MUCH LESS TIME THAN SUBSEQUENT CONVENTIONAL LECTURE PREPARATIONS, 6. PLATO INSTRUCTION REQUIRED LESS TEACHING ASSISTANCE THAN CONVENTIONAL LECTURES, 7. INSTRUCTOR'S TIME DURING ADMINISTRATION OF LECTURES FAR EXCEEDED THE AMOUNT NEEDED FOR THE ADMINISTRATION OF THE PLATO METHOD. (AUTHORS)

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August 1967

U.S. DEPARTMENT OF
HEALTH, EDUCATION, AND WELFARE

Office of Education
Bureau of Research

TEACHING LIBRARY USE TO UNDERGRADUATE: COMPARISON OF COMPUTER-BASED INSTRUCTION AND THE CONVENTIONAL LECTURE

Project No. 7-E-050
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Marina Esther Axeen

August 1967

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University of Illinois

Urbana, Illinois

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CHAPTER I

INTRODUCTION

Over the past three or four years, much has appeared in educational and technical publications and the popular press about programed* instruction and teaching machines.

The earliest "teaching" devices were developed in the 1920's by Professor Sidney L. Pressey,[1] of Ohio State University. His devices were designed primarily to test the student, with teaching only a secondary interest. The important characteristics of his devices were: (1) the student was presented with a device which contained multiple-choice questions covering material previously studied; (2) the student learned immediately from the device whether his answer to a question was correct or not.

With the aid of Pressey's device the student could determine for himself how well he had learned the material. Although Pressey published several articles about his work, they failed to spark much interest among educators.

In the middle and late 1950's, a new surge of interest occurred as a result of B. F. Skinner's experimentation on the Harvard campus.[2] His machine and program were based upon two important characteristics:

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*The grammatical rule (Markle, 1961) of spelling programed with one "m" when referring to programed instruction, and with two "m's" when referring to computer programming, is used throughout the thesis.

(1) students had to compose their responses rather than select from a set of alternatives; (2) to acquire learning, students had to pass through a carefully designed sequence of steps, each step being small enough that the students could understand them.

Up to this time, the teaching devices manufactured were very simple devices and limited as to the type of program they could present. Today the large-scale digital computer has made it possible to develop a more flexible teaching program. An example of such a system is PLATO (Programmed Logic for Automatic Teaching Operations) developed at the Coordinated Science Laboratory, University of Illinois.

In June 1965, the author began to develop a program on how to use the library employing the PLATO System. Fourteen units were written which cover the course content of Library Science 195--Introduction to the Use of the Library. The present study was undertaken to compare two methods of teaching (conventional lecture method vs. computer-based instruction).

The Problem.

The overall objectives of the present study were (1) to provide specific information concerning the effectiveness of computer-based instruction in teaching the use of the library, e.g., are the posttest scores significantly higher than the pretest scores for the experimental group receiving instruction on the PLATO Teaching System? (2) to compare the effectiveness of an automated programed instruction with the conventional lecture method as these relate to the knowledge students obtained, e.g., how do the posttest scores for the computer-based instruction compare with the posttest scores of the lecture method? (3) to compare the amount of instructor's time necessary to prepare and teach by computer-based instruction with the time spent in preparation and delivery of lectures in the classroom, (4) to compare the amount of time it took to cover the content of the course, e.g., how much time did the student spend using the computer-based method and the conventional lecture method?

Specifically the writer tested the following hypothesis: Undergraduate students taught how to use an academic library by programed instruction would learn as much, in less time with less instructional assistance, than would undergraduates taught by the conventional lecture method.

This paper presents a detailed description of the study, and a discussion of the results of the study in the light of the objectives outlined above. This paper also includes a general outline of the PLATO Teaching System.

Importance of the Study.

The determination of whether or not the basic assumption that programed instruction can be an equal or a better method of teaching undergraduates the use of the library should be of interest to educators and librarians alike.

To provide undergraduate students with instruction in the use of the library is a problem confronting almost every institution of higher learning. College and university librarians are finding it necessary to reevaluate their library instruction procedures. With the continuous increase in enrollment, this problem will continue to plague campus libraries, unless different methods are found to train large masses of students quickly, efficiently, and within reasonable expense.

Research has shown a definite need for library instruction on the undergraduate level.[3] Many college librarians would bear out this statement by Dr. Harold Taylor, former President of Sarah Lawrence College, that "sheer ignorance of how to work in a library betrayed by most students, graduates as well as undergraduates, and by young instructors is quite appalling."[4] There is no common background of experience, or common level of skill which freshmen can be expected to have.

A comprehensive literature study by William V. Jackson in Library Trends covered some thirty-one references commenting on formal and informal library instruction in undergraduate, graduate, and professional curricula. His conclusion was that "only further investigation, creative thinking, and positive action will remove such matters as library instruction from the category of unsolved problems."[5]

If the library is to be an effective tool, all students without minimum competencies in using library resources should be given early opportunity to develop the skills they need, and library instruction should be provided for all students who need it. The caliber of this instruction should be as high as that of instruction in the university's academic departments.[6]

With new media of communication and with current emphasis on independent study, it is appropriate to think of providing material which a student could use by himself, on his own initiative, and at his own speed. Programed instruction is largely a self-instructional technique and its potential with computer-based teaching systems needs to be explored.

Organization of the Study.

The remainder of this study is divided into eight major parts. The next chapter discusses studies using similar techniques and design. The third chapter will describe the PLATO Teaching System. Chapter IV will discuss the development of the library program. Chapter V will be devoted to the design of the study. Chapter VI will evaluate the study. Chapter VII will analyze the student responses and reactions, and the final chapter will present conclusions and implications based upon the findings.

Footnotes to Chapter I

1. Sidney L. Pressey, "A Simple Apparatus Which Gives Tests and Scores - Teaches," School and Society, XXIII (1926), 373-376.

2. B. F. Skinner, "Teaching Machine," Science, CXXVIII (1958), 969-977.

3. Peyton Hurt, "The Need of College and University Instruction in the Use of the Library," Library Quarterly, IV (1934), 436-448.

4. Library Instructional Integration at the College Level: Report of the 40th Conference of Eastern College Librarians held at Columbia University November 27, 1954 (ACRL Monograph, No. 13; Chicago: Association of College and Reference Libraries, 1955), p. 20.

5. William Vernon Jackson, "The Interpretation of Public Services," Library Trends, III (1954), 200.

6. Luella Snyder, The Second Kind of Knowledge (New York: Syracuse University Press, 1964), p. 7.

CHAPTER II

RELATED STUDIES

The past six years includes almost the entire history of research on programed instruction. Of 190 studies reported by Schramm, only twenty-five were made prior to 1960.[1]

The research has been largely preoccupied with issues regarding the properties which contribute most to learning. At least eighty per cent of the research has been concerned with presentation and response mode variables. The remaining studies have been on a variety of issues, particularly comparisons between programed and conventional instruction, and the effectiveness of programed instruction among various types of learner groups.[2]

Although many of these comparative studies involve elementary and high school students, a significant number relate to college level instruction. Of the thirty-six reports listed by Schramm as college experiments, sixteen of them compared programed instruction with conventional classroom instruction.[3] In his analysis of the thirty-six reports, he showed that eighteen studies resulted in no significant difference when the two groups were measured on the same criterion test; seventeen showed a significant superiority for the students who worked with the program, while only one showed a final superiority for the classroom students.[4]

Of the fifteen comparison studies cited by Silberman, nine favored the programed methods on learning scores and six showed no difference between them. In all fifteen studies, the programed groups took less time than the conventional groups.[5]

Not only does research favor or equate programed instruction to the conventional lecture method, but it also reveals that programed instruction is effective for a variety of different subjects.

In 1963, Carpenter and Greenhill[6] directed several studies at Pennsylvania State University. They concluded that achievement in a mathematics course and an English course were as good with programed materials as with conventional instruction.

Moore and Smith[7] tested various ways of presenting a program in psychology, such as asking for written responses or merely having the material read, employing free-responses or multiple-choices, and giving or not giving the student knowledge of results. They, too, found no significant differences on the criterion test between the various groups. Oakes[8] reported no significant difference between sections in an introductory psychology course taught by programed instruction and by conventional methods.

At Hamilton College,[9] classes in French, German, and logic were programed. Students taking the introductory French by program averaged about twenty per cent higher on a standardized test of written French, grammar, and translation, than students in the conventional lecture course; there was an average gain of twenty points on the standardized test in German for students in programed instruction; and in logic the gain on the average for students in programed instruction was ten points.

In 1960, at Temple University,[10] a course on Contemporary Secondary Schools was programed. No significant difference could be found between the experimental and control groups as measured by the second week quiz and the final posttest. The experimental groups saved forty-four per cent of the instructor's time.

In library instruction an experiment[11] under the direction of Paul R. Wendt at Southern Illinois University, Carbondale, used a teaching machine consisting of a Sarkes-Tarzian projector and a keyboard to instruct freshmen students on how to use the library. In this library experiment the participants were chosen at random from twelve sections of Freshman English. Four groups were assigned to learn to use the library from the teaching machine only (the experimental group), four groups learned the same content from a series of lectures (the control group), and another four groups received no instruction in the use of the library (the zero group).

Results showed no significant difference in achievement scores between the machine groups and the lecture groups, and both experimental and control groups were significantly better than the group which received no instruction. The report states that "since the hypothesis to be tested was that the machine could do as well as the lectures, and since the lectures had profited enormously from the programing technique and from the pictorial slides developed for the machine, this result was gratifying."[12]

Generally three findings have emerged from the research: a) the teaching machine can produce significant increments in learning; b) this beneficial effect is not limited to a particular subject matter or task; and c) machine teaching is applicable to a variety of learners.[13]

With the recent advent of the digital computer and its application to education, educators and researchers are exploring the use of computers to assist in the instructional process. Because of the flexibility, decision-logic characteristics, and input-output modes of a computer, computer-based instruction (CBI) is thought of as being more sophisticated than the traditional programed instruction and must be considered "as a quantum advance over traditional programed instruction."[14] The flexibility of the digital computer allows for a "variety of themes different from and richer than the themes of programed instruction as represented in a programed text or simple teaching machines."[15]

The use of a computer for teaching purposes is still in the exploratory stage. The purposes of a majority of the investigations have been to determine the feasibility of various programing, responding techniques, and to find out whether students could learn from this mode of instruction.[16]

There are a few groups which are currently experimenting with college course material presented on computer-based teaching systems. Karl Zinn[17] of the University of Michigan has compiled a list of these current projects throughout the United States. Most of this "in progress" research has been done with short programs over a short period of time. According to Zinn's compilation, the duration of these programs range from thirty minutes to a full semester course, with the majority for one or two hours in length in the fields of mathematics, physics, engineering, psychology, tests and measurements, languages, business, and library science.

Unfortunately, because of the limited research, no universal conclusions can be drawn. Uttal, from IBM, states that "it is entirely conceivable that a satisfactory theoretical and experimental foundation for teaching machines may not be laid down until long after such machines are contributing substantially to our educational system."[18]

However, certain advantages for computer-based teaching systems have been established. Some of these advantages are:

1. Computer-based teaching systems are more versatile and flexible than other types of teaching machines. Programmers are able to present a variety of materials in a more interesting manner to a variety of learners.
2. Students are able to progress at their own pace. Those who learn quickly are not held back, and those who are slow have a better chance of understanding the material. A computer-based terminal has infinite patience.
3. The learning sequence of the student is carefully controlled by the computer. This prevents cheating and forces the student to comprehend each frame.
4. Every constructed response is judged immediately for accuracy. It leaves no student wondering whether his response is correct or incorrect.
5. A complete record of student learning responses is tabulated by the computer for further analysis.
6. Parts of a program can be easily changed or modified without disturbing the entire program.
7. It can release the instructor's time for more individual work with students.
8. It can reduce the time required to bring a student to a satisfactory level of performance. This can be the economic pay-off, since instruction time is costly in both manpower and money.

At the Coordinated Science Laboratory at the University of Illinois numerous exploratory studies[19] have been conducted for the purpose of determining the capabilities of the PLATO System. The teaching research projects have included topics in engineering and mathematics, drill sequences for remedial arithmetic studies, on-line student-response analysis and editing, work in the area of verbal learning, retention and concept formation, clinical nursing instruction, and group interaction studies. The results of the teaching research conducted on the PLATO System to date have shown that the system can teach well, and has the flexibility needed to present a variety of materials.

The next chapter described in more detail the operation of the PLATO Teaching System.

Footnotes to Chapter II

1. Wilbur Schramm, The Research on Programed Instruction: An Annotated Bibliography (Washington: U. S. Department of Health, Education, and Welfare, 1964), pp. 17-107.

2. Arnold Bond Woodruff, Shinkichi Shimabukuro, and Sherman H. Frey, Methods of Programed Instruction Related to Student Characteristics, Cooperative Research Project No. 2284. (DeKalb: Northern Illinois University, 1965), p. 1.

3. Schramm, op. cit., p. 5.

4. Ibid.

5. Harry F. Silberman, "Characteristics of Some Recent Studies of Instructional Methods," Programed Learning and Computer-Based Instruction: Proceedings of the Conference on Application of Digital Computers to Automated Instruction, ed. John E. Coulson (New York: John Wiley and Sons, Inc., 1962), 18.

6. C. R. Carpenter and L. P. Greenhill, Comparative Research on Methods and Media for Presenting Programed Courses in Mathematics and English (University Park: Pennsylvania State University, 1963).

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9. John W. Blyth, et al., The Hamilton College Experiment in Programed Learning (Clinton, N.Y.: Hamilton College, 1962).

10. John B. Hough and Bernard Revsin, "Programed Instruction at the College Level: A Study of Several Factors Influencing Learning," Phi Delta Kappan, XLIV (1963), 286-291.

11. Southern Illinois University, *A Study to Determine the Extent to Which Instruction to University Freshmen in the Use of the University Library Can Be Turned Over to Teaching Machines*. (Carbondale, Illinois: Southern Illinois University, 1963).

12. *Ibid*., 9.

13. Lawrence M. Stolurow, *Teaching By Machine* (Cooperative Monograph, No. 6; Washington: U. S. Office of Education, 1961), p. 104.

14. Harold E. Mitzel, *The Development and Presentation of Four College Courses by Computer Teleprocessing* (Project #OE-4-16-010 Revised Interim Report; University Park: Pennsylvania State University, 1961), p. 7.

15. *Ibid*.

16. Walter Dick, "The Development and Current Status of Computer-Based Instruction," *American Education Research Journal*, II (1965), 47.

17. Karl L. Zinn, "Survey of Materials Prepared for Instruction or Instruction Research Via On Line Computer Systems," *Automated Education Letter*, I (April, 1966), 10-16.

18. William R. Uttal, "On Conversational Interaction," *Programed Learning and Computer-Based Instruction: Proceedings of the Conference on Application of Digital Computers to Automated Instruction*, ed. John E. Coulson (New York: John Wiley and Sons, Inc., 1962), 188.

19 Elisabeth R. Lyman, *A Descriptive List of PLATO Programs*, CSL R-296 (Urbana: Coordinated Science Laboratory, University of Illinois, 1966)

CHAPTER III

THE PLATO TEACHING SYSTEM

The Organization.

In 1960, the Coordinated Science Laboratory (CSL) at the University of Illinois began to develop and experiment with a computer-based teaching system called PLATO (Programmed Logic for Automatic Teaching Operations) in order to explore the possibilities of automatic individualized instruction for a large number of students.[1]

This system is currently in its third generation. The first model consisted of a single student station connected to ILLIAC I, a medium size computer built at the University of Illinois.[2] The second model had two student stations designed to study problems encountered with a multiple station system.[3] The third and current model consists of twenty student stations and uses the Control Data Corporation 1604 computer as the central control unit. Early investigations have determined that a general-purpose computer having a high-speed capacity would allow 1,000 students to be tutored concurrently.[4]

Each student receiving instruction on the PLATO System has a student station which consists of an individual keyset and a television screen as shown in Figure 1. It can be seen from this illustration that the student stations are isolated from each other by a partition, thus providing the separation needed for the maintenance of adequate experimental controls. In addition to the keyset and television display, all of the student stations have access to a slide selector referred to as an electronic book. This electronic book as shown in Figure 2 consists of a bank of pre-stored slides and is controlled by the

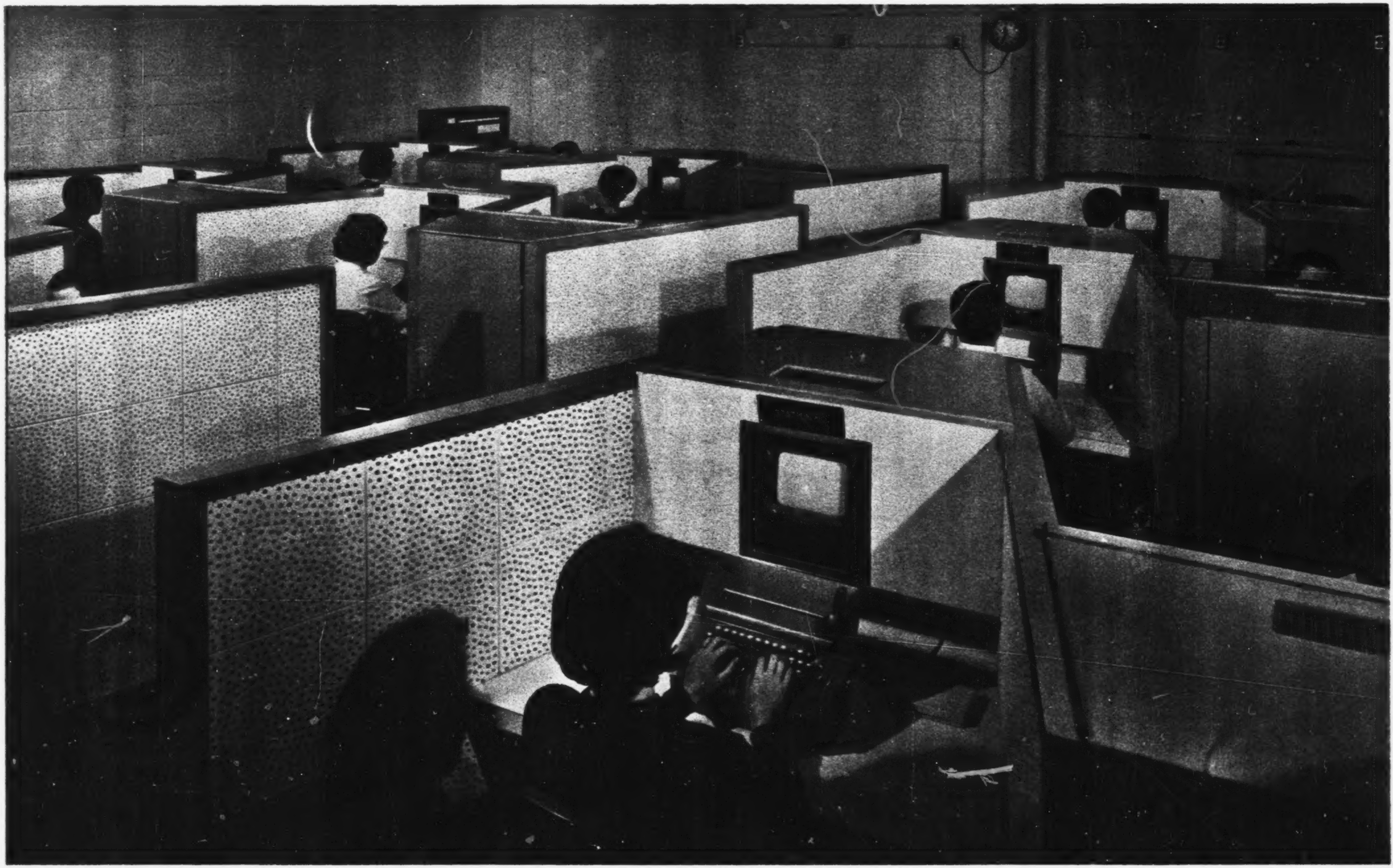


Figure 1 - A Photograph of the PLATO Classroom

central computer. The electronic book stores 122 slides and has a slide access time of less than a microsecond. Although the electronic book is shared by all of the students, the students can view the same or different slides simultaneously.

Each student station also has an electronic blackboard (Figure 2) which consists of a computer-controlled storage tube. Approximately forty alphanumeric characters can be written on a student's blackboard per second, and erased in two tenths of a second.[5] It is the images from the electronic blackboard and the electronic book which are superimposed on the student's tv screen. Figure 3 shows a block diagram of two student stations, indicating the shared and the individual parts of the system.

It is the keyset which allows the student to send information to the computer, and the television screen which presents the information prescribed by the computer program.

The rules governing the teaching process are included in the computer program read into the computer memory. The complete set of rules is referred to as a teaching logic. Any desired teaching logic may be programed into the system. At the present time about twenty different teaching logics have been written for the PLATO System; the most used are the tutorial and inquiry types. Non-technically trained teachers can write the text and computer material for PLATO by using existing generalized logics or by acquiring a brief knowledge of FORTRAN programming and then writing in PLATO compiler language, a version of Fortran-60 modified for PLATO use.[6] When an existing logic is used, the author of the programed material needs to provide the slide text

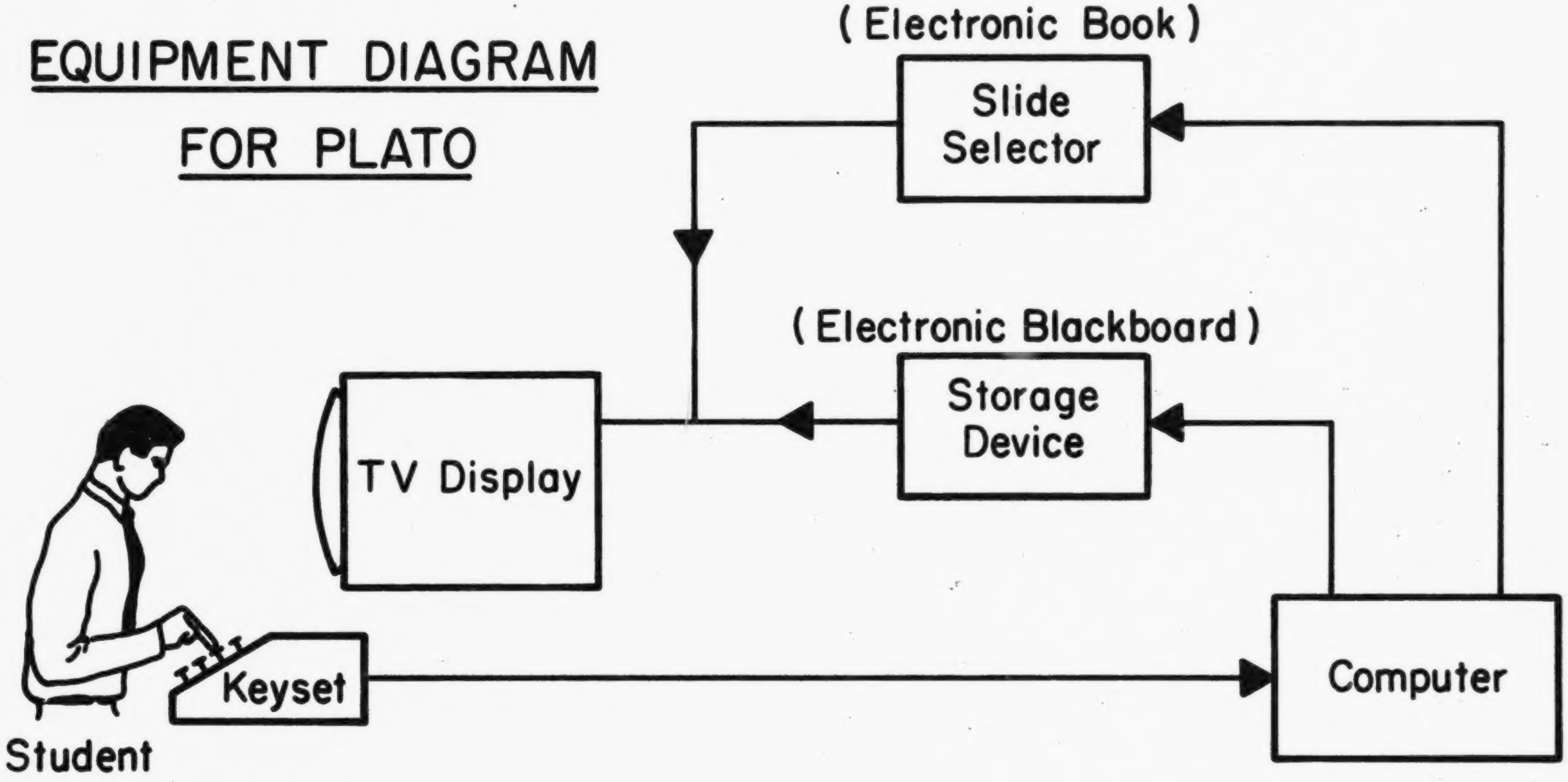

EQUIPMENT DIAGRAM
FOR PLATO
(Electronic Book)
Slide Selector
(Electronic Blackboard)
Storage Device
TV Display
Keyset
Student
Computer

Figure 2 - Diagram of the PLATO Teaching System (One Student)

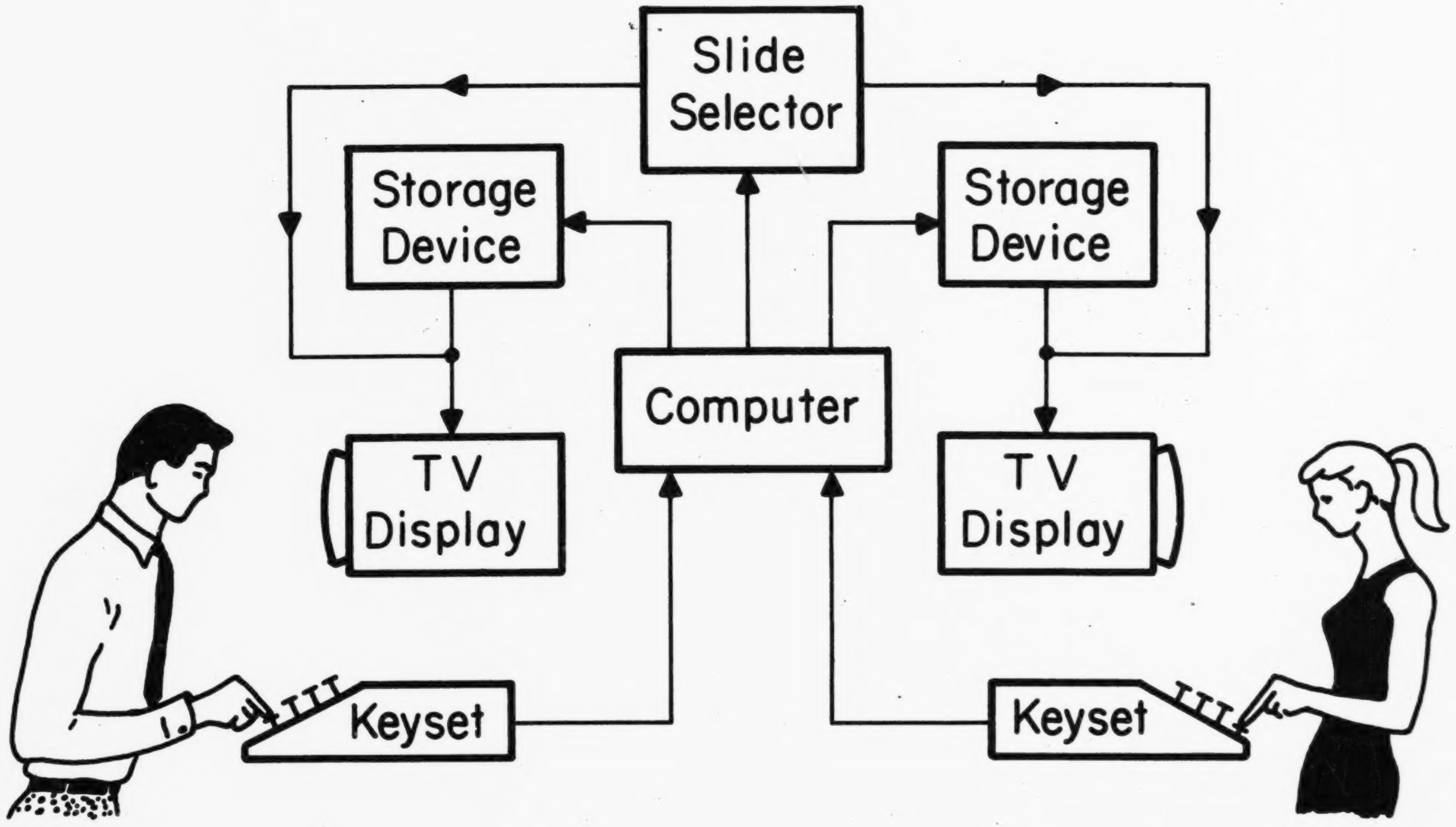

Slide Selector
Storage Device
Storage Device
Computer
TV Display
TV Display
Keyset
Keyset

Figure 3 - Block Diagram of Two Student Stations

and the appropriate parameters (e.g., page and problem description, branching, etc.) for each lesson.[7] Many teaching logics contain an "author-mode" for on-line program parameter editing. The "author mode" is that portion of the computer program to which only the author of the program has access. The author enters the "author mode" by pressing a combination of three keys, a combination unlikely to be discovered by a student. This facility allows the author to enter, change, or add to parameters in the computer memory from any one of the PLATO Station keyboards. Chapter IV describes in more detail the use of the tutorial author mode for this study.

An important feature of the PLATO System is the complete record of student responses which can be obtained. The computer writes on magnetic tape a record of each key that each student pushes, the time at which he pushed it, and the place in the lesson at which the key is pushed. Each student record can be processed at any time and in the statistical format desired; thus, student achievement, study reactions, and rate of learning can be examined and evaluated rapidly.

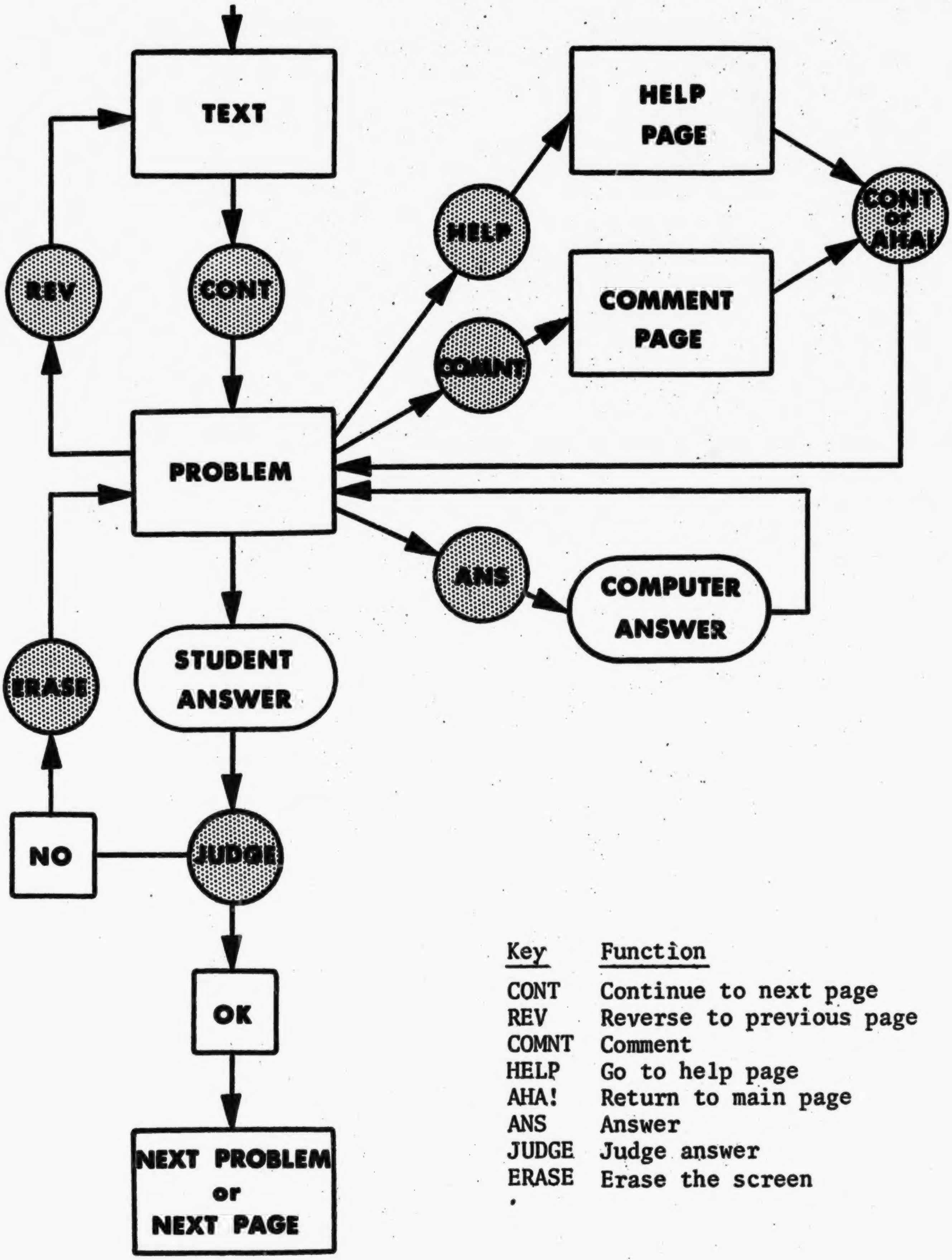
The Tutorial Logic.

In this experiment the tutorial logic was used. Since many readers may be unfamiliar with the tutorial logic, a description will be given. For an explanation of the inquiry logic consult R. L. Johnson, The Use of Programed Learning...[8]

A tutorial logic leads the student through a fixed sequence of topics, with a provision for branching between problems. The fixed sequence presents facts and examples, and then asks questions covering the material presented. The student responds to the questions asked by using keys on the keyset. The keys are divided into two types--those used to enter constructed responses, and those used to control the student's progress through the lesson material.

The lesson material is organized into two types of sequences (Figure 4): 1) the main sequence consisting of materials which must be viewed by all students, 2) the branch sequence for those students who have difficulty with questions in the main sequence.

The student begins by viewing the text material in the main sequence. After having read a page of text, the student proceeds to the next page by pushing the key on his keyset labeled "continue" or if the student wants to return to the preceding frame he pushes the key labeled "reverse". The typewriter keyboard contains alphanumerically-labeled keys and punctuation keys by which to enter responses. When the student feels that he is satisified with his answer, he presses the key labeled "judge". If the answer is correct, an "ok" is printed on the screen beside the responses; if an answer is wrong, a "no" or "sp" (spelling error) appears beside the response. The tutorial logic usually requires that all the questions on the page be answered. Until the student receives an indication that all his responses are correct, the "continue" key is inoperative. The student is allowed to make as many attempts as necessary to answer a question. If the student has difficulty with the question, he can press the key labeled "help" which will take him into a sequence containing additional information concerning the problem. If a student is unable to solve his problem he may ask for its answer by pressing the "answer" key.


TEXT
HELP PAGE
CONT or AHA!
HELP
REV
CONT
COMMENT PAGE
COMNT
PROBLEM
ANS
COMPUTER ANSWER
STUDENT ANSWER
ERASE
NO
JUDGE
OK
NEXT PROBLEM or NEXT PAGE

Key	Function
CONT	Continue to next page
REV	Reverse to previous page
COMNT	Comment
HELP	Go to help page
AHA!	Return to main page
ANS	Answer
JUDGE	Judge answer
ERASE	Erase the screen

Figure 4 - A Flow Diagram of the "Main" and "Help" Sequence

Special symbols and characters can be added to the basic keyset with only minor program changes. For example, for the library use experiment a special "underline" character was easily added for correct entry of bibliographic form.

The 122 slides available in the PLATO electronic book at one time were adequate for any one lesson or unit in the library use experiment. The maximum time allotted for each lesson in the library experiment was two hours. Students are informed when they have reached the end of the lesson by having the computer plot the words "End of Lesson" on the tv screen. When the student has completed an hour of instruction, the computer stores his stopping point, so that he may begin at the same place when he returns for the next session. Students may also review previously completed frames.

The teaching logic also makes provision for students to enter their comments into the computer. By pressing the key labeled "comment", the student can temporarily leave the student mode to enter a comment for the programmer. These comments typically refer to students' reactions to the lesson, or how they felt about the presentation of materials.

The Monitoring Procedure.

The PLATO System makes provision for monitoring each student in two ways: 1) by a remote console; 2) by the use of a "dope" tape. "Dope" stands for data obtained for program evaluation.

Real-time monitoring of students' performance is accomplished by using a remote console that is capable of duplicating any one of the student consoles. By the use of the remote console, it is possible to observe the performance of individual students.

The "dope" tape is a record of every key that was pressed at a student station. Every time a key is pressed at such a station, a record of this action is recorded on magnetic tape. This record indicates the station number, the key pressed, and the time it was pressed. From this record it is possible to analyze the performance of each student and get a clear image of individual student behavior, as well as what particular errors have been made.

The operation of PLATO as described indicates the nature of program materials which must be written for use on this teaching system. Chapter IV gives a description of the program used for the teaching of Library Science 195, Introduction to the Use of the Library.

Footnotes to Chapter III

1. Peter G. Braunfeld, "Problems and Prospects of Teaching with a Computer," *Journal of Educational Psychology*, 55 (1965), 201.

2. D. Bitzer, P. G. Braunfeld, and W. Lichtenberger, "PLATO; An Automatic Teaching Device," *IRE Transactions on Education*, E-4 (December, 1961), 158.

3. D. L. Bitzer, P. G. Braunfeld, and W. W. Lichtenberger, "PLATO II: A Multiple-Student, Computer-Controlled, Automatic Teaching Device," *Programed Learning and Computer-Based Instruction: Proceedings of the Conference on Application of Digital Computers to Automated Instruction*, ed. John E. Coulson (New York: John Wiley and Sons, Inc., 1962), 205-216.

4. Donald L. Bitzer, Elisabeth R. Lyman, and John A. Easley, Jr., *The Uses of PLATO: A Computer-Controlled Teaching System* CSL R-268 (Urbana: Coordinated Science Laboratory, University of Illinois, 1965), 14.

5. Donald L. Bitzer, Elisabeth R. Lyman, and John A. Easley, Jr., "The Uses of PLATO, A Computer-Controlled Teaching System," *Audiovisual Instruction*, XI (January, 1966), 18.

6. Donald L. Bitzer, "The PLATO Teaching System," *Automated Education Letter*, I (November, 1965), 15.

7. Donald L. Bitzer, *et al.*, *Lesson Preparation for the PLATO Tutorial Logic--Compiler Version*, CSL Report I-30 (Urbana: Coordinated Science Laboratory, University of Illinois, 1965).

8. Roger L. Johnson, *The Use of Programed Learning and Computer-Based Instruction Techniques to Teach Electrical Engineering Network Analysis*, CSL R-297 (Urbana: Coordinated Science Laboratory, University of Illinois, 1966), 11-12.

CHAPTER IV

DESCRIPTION OF THE LIBRARY PROGRAM

The preparation of the programed material for this study began in June, 1965. The program developed covers the course content of Library Science 195 - Introduction to Library Use, a course offered for credit to undergraduates by the University of Illinois Graduate School of Library Science. The course is intended for those students who need to become acquainted with the organization of the University Library, its catalog, and with a variety of reference tools.

Prior to writing the program the author taught this course by the lecture method. The first six lectures were devoted to historical development of the book and of libraries. The organization of books in libraries was dealt with next. The largest portion of the course was concerned with the use of basic reference tools. The final unit dealt with the making of a bibliography and footnotes. From this experience the author finally determined what units should be included in the automated program.

In September, 1965, a 923-frame program, excluding the "help" sequence, was completed and ready for use on the PLATO Teaching System. The program consisted of fourteen units, each unit instructing for a maximum of two hours. Table 1 gives the title of each unit, with the total number of frames in each, the number of "help" frames, the number of frames which require some type of response, and the number of responses required per unit.

TABLE I

SUMMARY OF FRAMES

Unit No.	Title of Unit	Number of Frames Per Unit In "Main" Sequence	Number of Frames In "Help" Sequence	Number of Frames Requiring Responses	Number of Questions to Answer Per Unit
1.	Development of books and printing	102	21	41	52
2.	Making of the book	53	23	35	105
3.	History and development of libraries	58	24	26	56
4.	Classification	43	26	25	127
5.	The Card catalog	90	35	56	164
6.	Shelf-list, serial record, and periodical rotary file	43	27	28	70
7.	Introduction to reference books	35	13	20	57
8.	Dictionaries	77	37	35	123
9.	Encyclopedias	95	26	42	83
10.	Biographical dictionaries	58	23	27	52
11.	Yearbooks	82	24	39	67
12.	Atlases & gazetteers	60	20	18	47
13.	Indexes	63	30	20	98
14.	Bibliography & footnote forms	64	5	18	23
	TOTAL	923	334	430	1124

Subject Content Covered.

The first three units are historical in nature, giving the student a brief survey of the development of printing, and the history of books and libraries with emphasis on outstanding people and historical events.

The Dewey Decimal Classification system is explained in detail in the fourth unit, along with some mention of the Library of Congress classification scheme.

In the fifth unit the functions and arrangement of the card catalog are presented, with emphasis given to the various types of cards in the card catalog and to the interpretation of the information on the cards. Other cards which are illustrated and discussed, are the cards in the shelf-list, serial file, and the periodical rotary file. These are covered in unit six.

A large portion of the program (units seven to thirteen) is devoted to the following classes of reference tools: dictionaries, encyclopedias, biographical dictionaries, yearbooks, atlases and gazetteers, and periodical and newspaper indexes. Within each class, selected reference tools are pictorially presented along with their important features. The questions to which the student responds refer either to an illustration for interpretation, or to the material already explained.

Type of Programming.

A combination of the Skinnerian "linear" program and Crowder's "intrinsic" or "branching" program was used in the development of lesson materials.

In the "linear" program the items are presented in a fixed sequence with every frame or slide viewed by the student. Constructed responses are frequently requested. The steps between items are short to ensure correct answers.

The "branching" program consists of long, expository frames with multiple-choice questions. Every correct response allows the student to proceed in the program. Incorrect answers branch the student to supplementary material designed to correct the particular error made. The student returns to the missed frame for correction before proceeding with the program.

The author has called a combination of Skinner-Crowder concepts the "linear-branching" technique which employs both constructed and multiple choice responses. This type of program allows for greater flexibility and gives students a change of pace.

The units used in this study resemble a linear program in that all frames are in a fixed sequence. The learner starts with frame one and proceeds in numerical order through the succeeding frames until the program is finished. Some of the frames give information in small blocks or steps, and the answers are frequently asked for, with immediate feedback which confirms the response.

The resemblance to a branching program is that some frames give large blocks of information followed by questions on the reading. If the students responds correctly, he can proceed. If not, the student branches to the "help" sequence which explains how to solve the problem.

For examples of frames see Appendix B.

Preparation of Frames.

In the preparation of the frames for the program, the following steps were followed:

1. A draft of each frame was prepared on a worksheet (see Appendix A). All the material was planned to fit the space provided.
2. On another slide form, the typist duplicated the information on the worksheet (see Appendix B). This space corresponded to the size of the student's tv display screen.
3. All needed illustrations were drawn in the drafting room and reduced to appropriate frame size and photographed (see Appendix B for samples).
4. After the illustrations were properly placed on the slide form with the proper text material, all the frames in a unit were photographed and mounted on two large plastic sheets for insertion into the electronic book portion of the PLATO equipment.

At the completion of this procedure, the slides were ready for display on the tv screen.

Preparation of Answer Sheets.

Before the predetermined responses were put into the computer, an answer sheet (Appendix C) had to be prepared for each unit.

On the answer form each slide was given a specific number. On the slides where one or more responses were required it was necessary to identify the "judger" number, the number of problems on the slide, the various answers, and the "help" sequence, if any.

Five different "judgers" were employed in the library use program. Table 2 gives the description and operation of the five judgers.

TABLE 2

JUDGERS USED IN THE LIBRARY USE PROGRAM WITH DESCRIPTION AND OPERATION OF EACH

Judger Number	Description	Operation
1	Does nothing	
2	Answer is always correct	Plots OK
4	Exact character by character	Correct answer - plots OK Wrong answer - plots NO
9	Calls the next slide in order that student's answer can be compared with the answer printed on that slide. The student's answer remains plotted on the screen at the same position.	Calls the slide whose number is one larger than present slide number.
10	Spelling judger	Correct answer - plots OK Misspelled answer - plots SP Wrong answer - plots NO

When the answer form was completed for each unit, then the information was ready to be entered into the computer memory.

The recording took place by converting any student or monitor keyset from the "student mode" to the "author mode". This is accomplished by pushing a set of predetermined keys. In the "author mode" individual slides are dealt with first. The slides in the electronic book are assigned a specific number, and these numbers must be referred to when dealing with individual slides. When the slide number is typed, the slide in that position immediately appears on the tv screen. For each slide the computer is given all the information needed, e.g., the location of the problem on the slide, the specification of the "judger" to be used in analyzing the student's responses, the answers which will be accepted, and the assigning of the "help" sequence.

When the information for each slide has been specified, the sequence in which the student will see the slides is determined. Page numbers are given to each slide. These page numbers are then assigned a "main page" number which indicates their position in the learning sequence. When this procedure is completed, the program is ready for operation.

The program described above was the basis for the experimental procedure used for this dissertation. The next chapter describes the experimental design of the study.

CHAPTER V

DESIGN OF THE EXPERIMENT

The Students.

The students who participated in this experiment were undergraduates who enrolled in Library Science 195 - Introduction to Library Use. Each semester, two sections of this course are offered for credit by the University of Illinois Graduate School of Library Science.

During the first semester 1965-1966, the students who enrolled for Library Science 195 at 10 a.m. were assigned to the control group. Students who enrolled for the afternoon section were designated as the experimental group. Since only ten PLATO student stations were available during the first semester this group was divided. Half of the group attended class from 6-7 p.m. on Monday and Wednesday and the other half on Tuesday and Thursday from 6-7 p.m. In the second semester of 1965-66, the afternoon class was assigned as the control group. This class was held from 2-3 p.m. The experimental group met in the morning from 9-10 a.m. Until twenty student stations were available on March 1, 1966, the experimental group was divided as in the previous semester, with half of the students meeting from 9-10 a.m. on Monday and Wednesday, and the other half meeting on Tuesday and Thursday from 9-10 a.m. After March 1, 1966, the experimental group met together from 9-10 a.m. on Tuesday and Thursday. In the third semester (first semester 1966-67) the morning class met from 10-11 a.m., and was designated as the experimental group, and the afternoon class became the control group and met from 3-4 p.m. Table 3 summarizes the time and day each group met during the three semesters.

TABLE 3

TIME TABLE FOR CONTROL AND EXPERIMENTAL GROUPS FOR THE THREE SEMESTERS

Semester	Group	Time	Day
1st 65/66	Control	10-11 a.m.	Tuesday & Thursday
	Experimental	6-7 p.m.	(Monday & Wednesday (Tuesday & Thursday
2nd 65/66	Control	2-3 p.m.	Tuesday & Thursday
	Experimental	9-10 a.m.	Tuesday & Thursday
1st 66/67	Control	3-4 p.m.	Tuesday & Thursday
	Experimental	10-11 a.m.	Tuesday & Thursday

Sixty-six students participated in the experiment. Thirty-four were in the control group and thirty-two in the experimental group. Of these sixty-six students, forty-one were females and twenty-five were males. Table 4 gives the sex distribution of the two groups for the three semesters.

TABLE 4

SEX DISTRIBUTION OF THE CONTROL AND EXPERIMENTAL GROUPS FOR THREE SEMESTERS

	1st Semester 65/66		2nd Semester 65/66		1st Semester 66/67		Total
	Control	Experimental	Control	Experimental	Control	Experimental	
Males	4	4	4	9	1	3	25
Females	9	8	6	4	10	4	41
Total	13	12	10	13	11	7	66

The students came from six colleges within the university. The largest number of students came from the College of Liberal Arts and Sciences. Table 5 lists the six colleges represented with the number of students in each college.

TABLE 5

DISTRIBUTION OF STUDENTS BY COLLEGES WITHIN THE UNIVERSITY

COLLEGES	STUDENTS
Liberal Arts and Sciences	37
Education	12
Fine and Applied Arts	9
Agriculture	5
Engineering	2
Physical Education	1
Total	66

As for class standing, over half of the students were either freshmen or sophomores.

TABLE 6

DISTRIBUTION OF STUDENTS BY CLASS STANDING

	1st Semester 65/66		2nd Semester 65/66		1st Semester 66/67		Total
	Control	Experimental	Control	Experimental	Control	Experimental	
Freshmen	4	6	5	3	4	2	24
Sophomores	4	4	4	6	1	3	22
Juniors	1	0	1	0	3	0	5
Seniors	4	2	0	4	3	2	15
Total	13	12	10	13	11	7	66

The student data sheet and the pretest scores indicated that no student had any previous formal instruction in the use of the library, and no student had previous experience with programed instruction.

An indication of each student's past performance was obtained from his university grade point average (5.00 system). Table 7 shows the means and standard deviations for each group per semester with an over-all mean and standard deviation for both groups for the three semesters.

TABLE 7

MEAN AND STANDARD DEVIATION FOR GROUPS PER SEMESTER PLUS AN OVER-ALL MEAN AND STANDARD DEVIATION FOR THE ENTIRE EXPERIMENT

Semester	Group	Mean	Standard Deviation
1st 65/66	Control	3.53	.55
	Experimental	3.71	.54
2nd 65/66	Control	3.53	.61
	Experimental	3.26	.72
1st 66/67	Control	3.49	.29
	Experimental	3.19	.11
All Semesters	Control	3.51	.5
	Experimental	3.39	.61

As previously indicated,the two groups (control and experimental) were arbitrarily assigned according to the section of the course in which the student enrolled. Table 7 shows that the two groups over all three semesters were well matched according to their grade point average using the random selection procedure previously described. The _t-test_ variance for the difference between the mean G.P.A. for the experimental and control group provided _t_=.21,which is nonsignificant at the .05 level.

The Testing Procedures.

All students participating in the experiment were given a pretest to measure the extent of their previous knowledge of the use of books and libraries. The pretest was given during the second class period of each semester. Upon completion of the instruction the same instrument was administered to all students as a posttest.

The test used as the pretest and posttest was the Library Orientation Test for College Freshmen[1] prepared by Edith M. Feagley, Dorothy W. Curtiss, Mary V. Gaver, and Esther Greene,and published in 1955 by the Teachers College, Columbia University.

The test is in nine parts covering the following areas:

I. Definition of terms
II. Interpretation of information on a card catalog
III. Choice of subject headings in the card catalog
IV. Arrangement of headings in the card catalog
V. Literature reference books
VI. Sources of biographical information
VII. Choices of indexes
VIII. Interpretation of information in periodical indexes
IX. Abbreviations commonly used in reference books

The test consists of eighty items of multiple choice and matching varieties. Sixty minutes were allowed for the completion of the test. Although the title of the test states college freshmen as the intended subject, the test manual indicates that any undergraduate groups may be tested with the instrument.

The initiator of this experiment chose this particular test because it represented the best instrument available to measure student's knowledge of the library.

The norms reported in the Manual For A Library Orientation Test For College Freshman[2] are based on 4,000 freshmen from fourteen colleges. The reported scores have a mean of 48.9 and a standard deviation of 11.3.

For reliability, the Kuder-Richardson formula No. 21 was used. This formula measures the degree of consistency of the test items.

The reliability coefficent is reported as .86 with a score point average of 4.2 for the standard error. This means that there is approximately one chance in three that a student's obtained score differs from his true score by as much as plus or minus 4.2 points.

There have been no statistical validation studies completed for this test at this time. In fact, at the present there is no standardized test available in the field of library science for testing a student's knowledge of the library.

A mid-term and final examination were administered to all students participating in the experiment. The mid-term examination covered the first six units of the course. The final examination included material covered in the last seven units of the course. Each test had a total of one hundred items. No statistical evaluation will be made of the mid-term or final examinations because both of these tests were teacher-made instruments and not standardized tests.

The Experimental Procedure.

The students participating in this experiment began by taking the pretest described. After this the group designated as the experimental group was instructed to meet in the PLATO classroom at the Coordinated Science Laboratory. Upon receiving an introduction to the PLATO System and becoming familiar with the student station and keyset, the students in the experimental group began to attend fifty minute class periods twice a week. This procedure was followed until the instruction on the teaching system was completed.

The control group received their instruction by the lecture method. The same person who structured the PLATO program also delivered the lectures, and the control group met for the same amount of time per week as the experimental group.

At the first meeting of the class, all students received an outline of the course with the assigned and supplementary readings.

Problem sheets were prepared for distribution after the completion of certain units. There were a total of ten problem assignments. To solve the questions on the problem sheet, students had to use the university library facilities. A sample of these problem sheets can be found in Appendix D.

During the second semester 1965/1966, and the first semester 1966/1967, each student in the experiment was requested to keep a study log. This study log asked the student to keep an account of the time he spent on the reading assignments (text and supplementary readings) and the time spent on library problems.

During the last week of instruction in each semester, the Illinois Course Evaluation Questionnaire was filled out by both groups.[3] The questionnaire consists of fifty statements relating to instruction. Each student indicated whether he strongly agreed, agreed, disagreed, or strongly disagreed with these statements. The instructor of this course also prepared an attitude questionnaire which was given to the experimental group. This questionnaire was given during the last week of instruction, and it contained eight questions to which the student responded yes, no, or undecided.

The posttest, described under testing procedures, was administered during the university's final examination period.

The statistical results of the investigation are described and evaluated in the succeeding chapter.

Footnotes to Chapter V

1. Ethel M. Feagley, *et al.*, *A Library Orientation Test For College Freshmen* (New York: Teachers College Press, 1955).

2. ______________., *Manual For A Library Orientation Test For College Freshman* (New York: Teachers College Press, 1961), 6-7.

3. Richard E. Spencer, *Illinois Course Evaluation Questionnaire*, Form 66 (Urbana: Office of Instructional Resources, University of Illinois).

CHAPTER VI

STATISTICAL EVALUATION OF THE STUDY

This chapter is devoted to the analyses of data as they relate to the following four problems undertaken in this study: (1) How do the posttest scores for the computer-based instruction compare with the posttest scores of the conventional lecture method? (2) Are the posttest scores of the experimental group significantly different from the pretest scores? (3) How much time did each student in the experimental group spend at the PLATO console as compared to the amount of time the control group spent receiving instruction in the classroom? (4) How much time did it take the instructor to prepare the computer-based teaching material as compared with the preparation and delivery of classroom lectures?

An analysis of variance was performed to answer the above stated questions. This procedure allowed for an examination of the various group and test-retest means to determine if they differed significantly one from another.

The analysis of variance was a 2 x 2 repeated measure design. The two groups (experimental and control) were measured on both the pretest and posttest, and the pairs of scores for each person in each group were used. This procedure was used as opposed to grouping all pretest scores and all posttest scores together without regard to the fact that each person was measured twice.

The summary of this analysis of variance computation is shown in Table 8.

TABLE 8

ANALYSIS OF VARIANCE SUMMARY TABLE

Source of Variance	Sum of Squares	df	Mean Square	F Ratio
Type of Group	207.07	1	205.07	4.55*
Test-Retest	3059.01	1	3059.01	67.94**
Groups by Test-Retest	11.19	1	11.81	.25
Students (Residual error)	5943.73	132	45.03	
Total	9219.00	135		

* $p < .05$
** $p < .01$

The measure of the degree of significance of the differences between the groups or between the test-retest is the F ratio (F). From a table of F values, it can be determined whether or not this F ratio is significantly different between the group means. If the F value is larger than the tabled F values, the F is said to represent a significant difference between the groups means.

Associated with each F is a pair of degrees of freedom (df). These degrees of freedom are determined by (1) the number of levels of each independent variable, and (2) the number of cases in each group. The pair of degrees of freedom determine the proper value of F in the F Table. If the observed F ratio exceeds the proper F value in the F Table, the observed difference between group means is significant.

In Table 8, the significant F ratio for test-retest indicates that computer-based and lecture methods both resulted in significant student gains in the knowledge of library use ($F = 67.94$, $p < .01$). The significant difference between the experimental and control groups ($F = 4.55$, $p < .05$) was due to the over-all difference between the mean of the control and experimental groups. This was because the experimental group achieved a lower score than did the control group on both occasions. However, the comparisons between experimental and control groups for pretest indicated that the difference between the groups was not significant at the 5% level.[1*] Hence, the groups were probably drawn from the same population with regard to their knowledge of library use.

Further, and more critically for this study, the non-significant interaction of groups x test-retest suggested that no significant further divergence took place between the means of the experimental and control groups as a result of the respective treatments (see Figure 5).

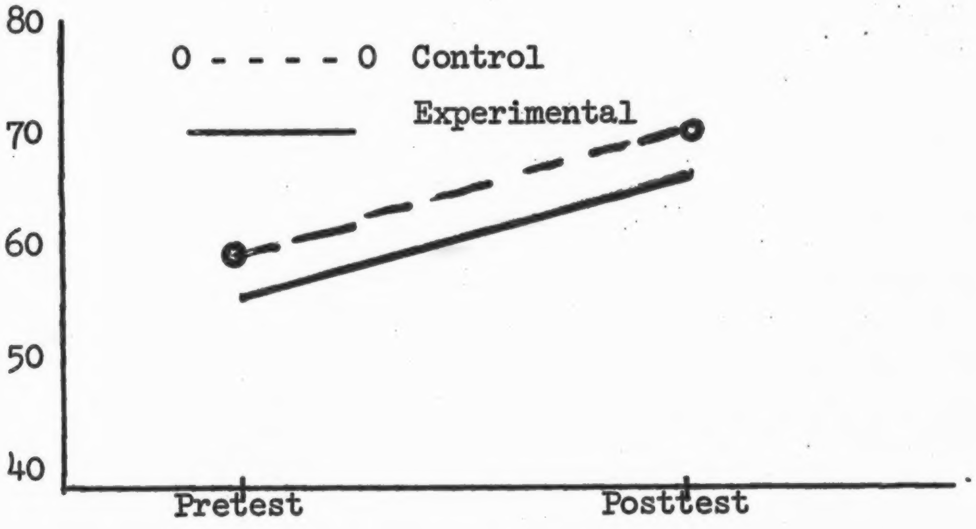


Figure 5 PLOTTING OF PRETEST AND POSTTEST MEANS OF CONTROL AND EXPERIMENTAL GROUPS

Indications of the gains in knowledge of the library use for both groups are demonstrated in Table 9.

---

* Mathematics of difference between control and experimental groups on pretest

$$t_{df} = 132 = \frac{\bar{X}\text{ Exp.} - \bar{X}\text{ Control}}{\sqrt{\frac{S\text{ error}}{N}(\not\leq a\ 2)}} = \frac{54.56 - 56.44}{\sqrt{\frac{45.03\ (2)}{34}}} = -1.15$$

(Hays, p.483)

TABLE 9

SUMMARY OF MEANS BY GROUPS AND TEST
(Maximum possible score = 80 points)

Group	Pretest	Posttest
Experimental	54.56	63.47
Control	56.44	66.5
Total	55.50	64.99

Out of a possible score of 80, the experimental group mean indicated a gain of 8.91, while for the control group there was a gain of 9.49.

A one-way analysis of variance was performed on both experimental and control groups to determine whether the amount of gain (from pretest to posttest) was related to pretest scores. Each group was divided into thirds on the basis of pretest scores as shown in Table 10. The greatest group mean gain for the control group was with the bottom third group. For the experimental groups the middle third group made the largest gain. The two top third subgroups showed the least group mean gains. It is possible that this small gain is due to a "ceiling" effect. With the highest possible score being only eighty, neither top third subgroup could evidence much improvement. The other subgroups, on the basis of lower pretest scores, had a larger range for improvement between pre and posttest scores.

The higher the pretest score the lower the gain; the lower the pretest score, the higher the gain. This movement can be explained generally by the concept of the regression toward the mean, which helps account for the differences in gains between the top-middle-bottom subgroups scores given in Table 10.

TABLE 10

SUMMARY OF A ONE-WAY ANALYSIS OF VARIANCE WITH GROUPS (CONTROL AND EXPERIMENTAL) DIVIDED INTO THIRDS

CONTROL GROUP	Pretest Range of Scores	Group	Group Mean Gain	Group Standard Deviation
Top Third	68-60	10	7.0	4.9
Middle Third	59-55	14	9.8	5.7
Bottom Third	54-43	10	13.5	9.5
Total		34	10.0	
EXPERIMENTAL GROUP				
Top Third	70-60	10	6.3	3.7
Middle Third	59-50	13	10.8	6.3
Bottom Third	49-41	9	9.1	8.9
Total		32	8.9	

It should be noted from Table 10 that the groups were not of equal size. This was done as a matter of convenience, as division of the groups into equal thirds would have resulted in the assignment of persons with the same pretest scores to two different groups.

The total class time for each of the three semesters was thirty hours, of which twenty-six hours were given exclusively to instruction. The remaining four hours were devoted to the introduction to the course, and to three examinations (pretest, mid-term, and posttest). The final examination was given during the week of regular university final examinations, and it was not included in the thirty hours of class time per semester. All calculations of instructional time are based on a fifty-minute class hour.

Students in the control group spent twenty-six class hours receiving instruction. For the experimental group the instructional time varied, and in all cases it was less than the twenty-six class hours spent by the control group. Table 11 indicates the mean class time for both groups over each semester with an over-all mean for the three semesters.

TABLE 11

MEAN CLASS TIME PER SEMESTER WITH OVER-ALL MEAN FOR ALL SEMESTERS IN HOURS

Semesters	Experimental Group	Control Group
1st Semester 65/66	17.75	26.0
2nd Semester 65/66	17.20	26.0
1st Semester 66/67	19.51	26.0
All Semesters	17.91	26.0

The experimental groups over-all mean for the three semesters was 17.91 hours, which averages about eight class hours less in instructional time per semester for the control group. On the basis of two class hours of instruction per week, the students in the experimental group completed their instruction four weeks earlier than the control group.

Between semesters, the experimental group's instructional time varied approximately two hours. As indicated in Table 11, the time spent by the experimental groups in the first two semesters was approximately the same--17.75 and 17.20 class hours respectively. For the first semester 66/67 an additional two hours were needed, totaling 19.51 class hours in all.

A t-test was performed to determine whether any difference existed between groups on the basis of mean gains per class hour, defined as the total gain divided by the number of class hours of instruction. The observed value of t was 2.05 which is significant at the .05 level, but not at the .01 level. Referring back to the means of the two groups, it was determined that the average points gained per class hour was significantly higher for the experimental group (.54) than the control group (.36).

Case studies were done of four students who made the highest point gains between pre and posttest. Two of these students were from the experimental group and two from the control group. Both sexes are represented. All four of these students were in the experiment during the same semester and each made gains of eighteen or nineteen points.

> Student A was a freshman enrolled in the College of Engineering and a member of the control group in the experiment. He was a graduate of a large suburban high school near Chicago, Illinois. The student indicated no previous library instruction nor any employment in a library. While enrolled in Library Science 195--Introduction to Library Use, this student carried nineteen credit hours with an indicated major in electrical engineering. The student's grade point average was 3.56. (Pretest score - 51; posttest score - 70)
>
> The student showed interest in the class, recited frequently, and worked hard on assignment problems.
>
> Student B was a member of the control group in the experiment. She was a freshman enrolled in the College of Liberal Arts and Sciences and a graduate of one of the Chicago suburban high schools. Her grade point average at the University of Illinois was 2.57. Student B had no previous library instruction nor library employment. While enrolled in Library Science 195--Introduction to Library Use, the student was carrying fifteen hours of instruction. This student did not indicate a major field. (Pretest score - 53; posttest - 72)

Student B continually displayed anxiety over school work and expressed several times the need to raise the grade point average. During the entire course there was need to give added explanation on library assignments and what was presented by lecture. When the library assignments were completed they were correct and well done.

Student C was a sophomore in the College of Liberal Arts and Sciences, majoring in advertising. Student C had a grade point average of 3.86 and was carrying sixteen credits of instruction while enrolled in Library Science 195. She graduated from a Chicago high school and indicated no previous library instruction nor employment in a library. (Pretest score - 53; posttest score - 71)

Those in the experimental group had the opportunity to express their likes and dislikes of the course on the teaching system by pressing the "comment" button and typing in comments. Student C indicated that the course was very useful and interesting. An analysis of the program print-outs indicated that Student C did above average with the program on PLATO and completed the program in 14.60 hours. No difficulty was observed in the transferring of knowledge learned on the teaching system and the problems to be completed in the library.

Student D was a sophomore enrolled in the College of Liberal Arts and Sciences, majoring in math education. Student D graduated from a medium size high school in Illinois. The student had a grade point average of 2.84. This student gave no indication of any previous library instruction or library employment. (Pretest score - 55; posttest score - 73)

The typed comments on PLATO revealed that this student found the method of teaching interesting and enjoyable. The response print-outs and the library assignments revealed that this student was a very careful worker. The program was completed in 19.60 hours.

During the second semester 65/66 and the first semester 66/67, each student kept a record of the time spent on reading assignments and library problems outside of class. As indicated in Table 12 the difference between the means of the experimental and control groups and the over-all mean is not significant. On the average, each student spent a little more than one hour in preparation for each hour of instruction.

TABLE 12

MEAN HOMEWORK TIME PER SEMESTER
WITH OVER-ALL MEAN FOR TWO SEMESTERS

Semesters		Experimental Group	Control Group
2nd Semester	65/66	32.42	34.43
1st Semester	66/67	30.91	33.22
Total		31.89	32.26

As for points gained for each hour (sixty minutes as opposed to a fifty minute class hour) of homework, the groups as indicated in Table 13 did not differ significantly. The observed t value was 0.16, which is non-significant at the .05 level.

TABLE 13

MEAN GAIN PER HOUR OF HOMEWORK
FOR TWO SEMESTERS

Groups	2nd Semester 65/66	1st Semester 66/67	Over-all Mean
Experimental Group	.41	.32	.38
Control Group	.40	.37	.39

Correlation between time spent in class, grade point averages, and gains for students receiving the control and experimental treatments revealed, as shown in Table 14, that no relationship existed between: (1) grade point averages and gain, or (2) grade point and time spent in class, or (3) gains and time spent in class.

TABLE 14

CORRELATION BETWEEN TIME SPENT IN CLASS, G.P.A., AND GAIN FOR STUDENTS RECEIVING CONTROL AND EXPERIMENTAL TREATMENTS

	Time in Class	G.P.A.	Gain
CONTROL GROUP			
Time in Class	1.0	0.0*	0.0*
G.P.A.	---	1.0	-.035 (N=28)**
Gain	---	---	1.0
EXPERIMENTAL GROUP			
	Time in Class	G.P.A.	Gain
Time in Class	1.0	.000 (N=26)**	-.003 (N=32)
G.P.A.	---	1.0	-.079 (N=26)**
Gain	---	---	1.0

* Since all control group students spent twenty-six hours receiving the treatment, these correlations (r=0.0) would be meaningless.

** G.P.A. were not available for 1st semester Freshmen, therefore the number who had grade point average for the control group was twenty-eight and for the experimental group twenty-six.

In the preparation of lesson material, the author spent sixty hours a week for sixteen weeks developing and preparing the fourteen unit program on library use to be presented on the PLATO teaching system. In contrast, the author estimates two hours of preparation were required for each one hour class lecture given to the control group.

It is possible that a program could be written at a faster rate as one becomes familiar with the teaching system and all of its possibilities. This was the author's first attempt at programed instruction for a computer-based teaching system.

In making a comparison of time two advantages of programed instruction on a computer-based system should be kept in mind: (1) Once a program has been developed, it can be used repeatedly, (2) Most revisions can be accomplished without changing the basic program. Over a period of time, programed instruction used on a computer-based teaching system might bring savings in instructional time and in preparation.

For experimental purposes it is estimated by Dr. Donald L. Bitzer, Research Associate Professor of the Coordinated Science Laboratory of the University of Illinois, that it costs five dollars per student per hour to operate the computer and the PLATO teaching equipment. New developments are being made to reduce this per student cost. Just recently it was announced that three University of Illinois men at the Coordinated Science Laboratory had invented a plasma panel which probably will replace the cathode ray tube and reduce the cost of the tv equipment per station from about \$5000 to about \$500 per unit.[2]

With a decrease in the cost for student stations, and with a computer which has the capacity simultaneously to instruct over one thousand students, the per student rate of five dollars per hour should be greatly reduced in a few years.

To summarize, we can say that: (1) there is no significant over-all difference between scores of the experimental and control groups; (2) both programed instruction and the lecture method caused significant amount of learning; (3) a significantly less amount of class time was spent by the experimental group using the PLATO teaching system than by the control group; (4) the same amount of time was spent on homework by both groups; (5) the amount of initial preparation time by the instructor was much greater for the PLATO System than for the lecture method. However, as previously stated, once the program on the PLATO System has been developed it can be used repeatedly with little or no additional time.

Chapter seven presents the analysis of student responses resulting from the experimental study.

Footnotes to Chapter VI

1. William L. Hays, Statistics for Psychologists (New York: Holt, Rinehart, and Winston, 1963), p. 483.

2. Champaign-Urbana Courier, March 13, 1967, p. 19.

CHAPTER VII

ANALYSES OF STUDENT RESPONSES AND REACTIONS

During the three-semester experiment on PLATO a complete record of student responses for the experimental group (N=32) was kept on magnetic tape. Print-outs of these responses were available after each class session.

These print-outs not only recorded student responses per unit, but also summarized the responses per student. This summary was tabulated into seven categories: (1) number of "no's" received; (2) number of "ok's" received; (3) number of "helps" requested; (4) number of "answers" requested; (5) number of "reverses" made on the teaching machine; (6) number of "spelling errors"; and (7) "erasures". Table 15 gives a sample of how this summary appears on the print-out.

TABLE 15

EXAMPLE OF STUDENT RESPONSE SUMMARY FOR A CLASS PERIOD

Student	No's	Ok's	Help	Ans.	Rev.	Sp.	Erasures	Lapsed Time
2	12	28	1	0	35	4	22	44.72
3	4	14	2	1	11	0	6	45.52
4	0	0	0	0	0	0	0	.00
5	8	20	12	2	11	2	25	47.47

The abbreviation Ans. stands for answer; Rev. for reverse; and Sp. for spelling error.

These responses were added together when the unit was completed. As previously stated each unit was planned for two one-hour class periods. Student 4 with all 0's indicates that station number 4 was not used during the class period. Each student in the experimental group was given an assigned station number.

To establish some indication of the level of difficulty of the various units, the author computed the over-all mean on each of the seven categories for each unit. Table 17 reports these computations. The two numbers typed under each unit number indicate the number of questions which require an answer in the unit and the total number of frames in the particular unit. Therefore 52/102 typed under Unit I should be interpreted as 52 questions to be answered with a total of 102 frames in Unit I.

In all units fifty percent or more of the questions were answered correctly by the students on their first attempt. Table 16 indicates these percentages.

TABLE 16

PERCENT OF "OK'S" PER UNIT RECEIVED BY STUDENTS ON FIRST ATTEMPT

Unit No.	Subject	Percent
1	Development of books and printing	67
2	Making of the book	73
3	History and development of libraries	71
4	Classification	85
5	The card catalog	71
6	Shelf-list, serial record, and periodical rotary file	76
7	Introduction to reference books	56
8	Dictionaries	85
9	Encyclopedias	88
10	Biographical dictionaries	63
11	Yearbooks	76
12	Atlases and gazetteers	79
13	Indexes	50
14	Bibliography and footnote forms	87

TABLE 17

OVER-ALL MEANS FOR STUDENT RESPONSES PER UNIT

RESPONSES	No's	OK's	Helps	Answers	Reverses	Spelling	Erasures
Units							
I (52/102)	14	35	14	14	41	3	36
II (105/53)	18	77	8	18	24	5	30
III (56/58)	14	40	8	14	20	7	19
IV (127/43)	23	108	6	27	27	5	31
V (164/90)	45	116	5	32	32	6	54
VI (70/43)	17	53	3	18	15	3	24
VII (57/35)	12	32	2	17	11	2	14
VIII (123/77)	20	104	2	10	11	2	24
IX (83/95)	12	73	4	15	17	3	23

TABLE 17 (CON'T)

OVER-ALL MEANS FOR STUDENT RESPONSES PER UNIT

RESPONSES	No's	OK'S	Helps	Answers	Reverses	Spelling	Erasures
Units							
X (52/58)	17	33	4	13	19	4	15
XI (67/82)	16	51	6	17	31	4	23
XII (47/60)	8	37	4	6	22	3	13
XIII (98/63)	26	49	9	25	38	9	30
XIV (23/64)	3	20	1	3	19	1	9

Judged by the percent of "ok's" received on the first response, Unit 7 (Introduction to reference books) and Unit 13 (Indexes) seemed to be the most difficult. These were the only two units with percentages in the fifties. All other units rated between sixty-three and eighty-five percent.

As for "no's" received, Table 18 indicates the percent per unit.

TABLE 18

PERCENTAGE OF "NO'S" RECEIVED PER UNIT BY STUDENTS

Unit No.	Subject	Percent
1	Development of books and printing	27
2	Making of the book	17
3	History and development of libraries	25
4	Classification	15
5	The card catalog	27
6	Shelf-list, serial record, and periodical rotary file	24
7	Introduction to reference books	24
8	Dictionaries	15
9	Encyclopedias	12
10	Biographical dictionaries	32
11	Yearbooks	24
12	Atlases and gazetteers	17
13	Indexes	27
14	Bibliography and footnote forms	13

The highest percentage of "no's" received in any one unit was thirty-two percent. This was Unit 1C, which dealt with biographical dictionaries.

A student may attempt to answer a question several times and repeatedly get a "no" instead of asking for "help" after the first "no" was received. He may also receive a "no" if the answer is correct but not identical to the correct answer already in the computer. With is in mind, the number of "no's" received per unit was rather low.

Table 19 indicates that the use of the "help" sequence was slight. There are several reasons for these low percentages. Students could get assistance in other legal ways besides pushing the "help" button.

TABLE 19

PERCENTAGE OF "HELP" FRAMES USED BY STUDENT PER UNIT

Unit No.	Subject	Percent
1	Development of books and printing	0.53
2	Making of the book	0.09
3	History and development of libraries	0.20
4	Classification	0.20
5	The card catalog	0.10
6	Shelf-list, serial record, and periodical rotary file	0.07
7	Introduction to reference books	0.10
8	Dictionaries	0.05
9	Encyclopedias	0.12
10	Biographical dictionaries	0.14
11	Yearbooks	0.20
12	Atlases and gazetteers	0.18
13	Indexes	0.34
14	Bibliography and footnote forms	0.08

A student could get help by pushing the "answer" button. In examining the number of times an "answer" was requested per unit, this reasoning seems logical. Table 20 gives, in percentages, the number of times the "answer" button was used per unit.

TABLE 20

AMOUNT OF TIME THE "ANSWER" KEY WAS USED PER UNIT

Unit No.	Subject	Percent
1	Development of books and printing	27
2	Making of the book	17
3	History and development of libraries	25
4	Classification	21
5	The card catalog	20
6	Shelf-list, serial record, and periodical rotary file	26
7	Introduction to reference books	30
8	Dictionaries	08
9	Encyclopedias	18
10	Biographical dictionaries	25
11	Yearbooks	25
12	Atlases and gazetteers	13
13	Indexes	26
14	Bibliography and footnote forms	13

Another means by which a student could get help was to press the "reverse" button and reread the material until the answer was found. Table 21 shows in percentages the number of times the "reverse" button was used per unit.

TABLE 21

PERCENTAGE OF TIMES THE "REVERSE" BUTTON WAS USED PER UNIT

Unit No.	Subject	Percent
1	Development of books and printing	40
2	Making of the book	45
3	History and development of libraries	34
4	Classification	63
5	The card catalog	36
6	Shelf-list, serial record, and periodical rotary file	35
7	Introduction to reference books	31
8	Dictionaries	14
9	Encyclopedias	18
10	Biographical dictionaries	33
11	Yearbooks	38
12	Atlases and gazetteers	37
13	Indexes	60
14	Bibliography and footnote forms	30

It should be pointed out that students used the "reverse" button for review purposes as well.

Errors due to misspelling were small. Table 22 shows the percentages.

TABLE 22

PERCENT OF "SPELLING ERRORS" PER UNIT

Unit No.	Subject	Percent
1	Development of books and printing	0.06
2	Making of the book	0.05
3	History and development of libraries	0.13
4	Classification	0.04
5	The card catalog	0.04
6	Shelf-list, serial record, and periodical rotary file	0.04
7	Introduction of reference books	0.04
8	Dictionaries	0.02
9	Encyclopedias	0.04
10	Biographical dictionaries	0.08
11	Yearbooks	0.06
12	Atlases and gazetteers	0.06
13	Indexes	0.09
14	Bibliography and footnote forms	0.04

Erasures in the answers on the program are given in Table 23. Not all experimental students were proficient in typing, but on the whole this did not seem to hinder their work. It might be better if another means of recording input such as a pencil were used. This method would eliminate any typing difficulty which may be encountered by students with non-typing abilities.

TABLE 23

PERCENT OF "ERASURES" PER UNIT

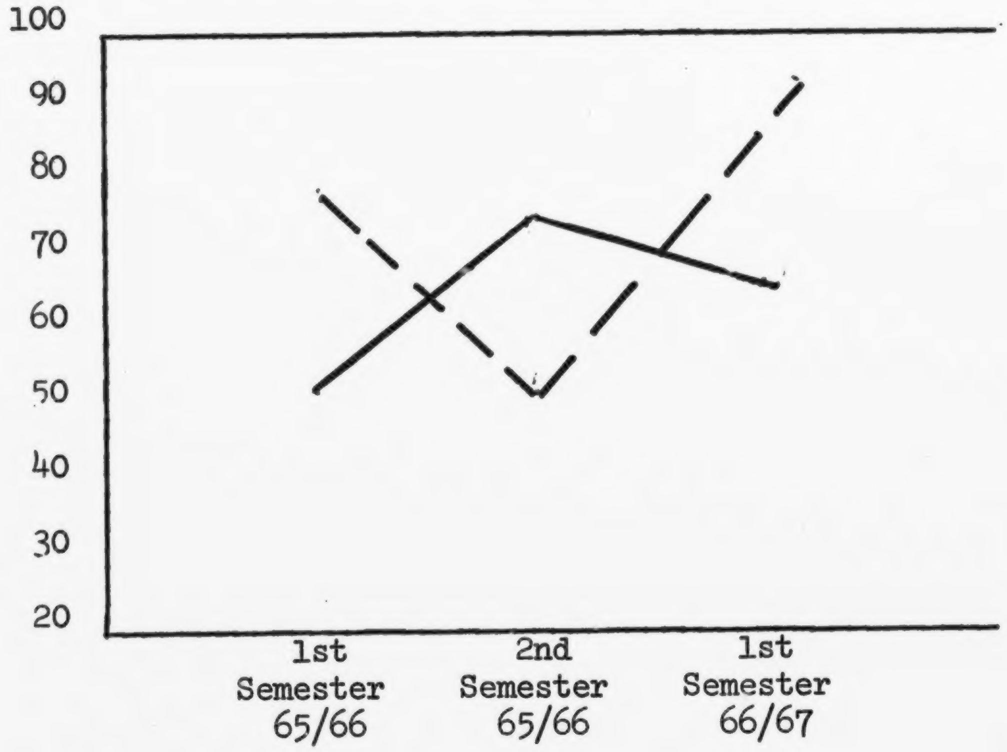
Unit No.	Subject	Percent
1	Development of books and printing	69
2	Making of the book	29
3	History and development of libraries	34
4	Classification	24
5	The card catalog	33
6	Shelf-list, serial record, and periodical rotary file	34
7	Introduction of reference books	25
8	Dictionaries	20
9	Encyclopedias	28
10	Biographical dictionaries	29
11	Yearbooks	34
12	Atlases and gazetteers	28
13	Indexes	31
14	Bibliography and footnote forms	39

Table 24 expresses the attitude rating which the control and experimental groups gave to Library Science 195--Introduction on How to Use the Library. The control group is represented by the solid line and the experimental group by a broken line.

According to semesters the over-all course ratings for the control group were 50%, 73%, and 65%; for the experimental group these ratings were 76%, 50%, and 94%.

TABLE 24

ATTITUDE MEASURES FROM THE COURSE EVALUATION QUESTIONNAIRE EXPRESSED IN ALL-UNIVERSITY PERCENTILE NORMS.
(CONTROL GROUP REPORTED BY SOLID LINE,
THE EXPERIMENTAL GROUP BY BROKEN LINE.)



Items measured include general course attitude, method of instruction, course content, interest and attention, instructor, and other specific items.

The ratings for the three semesters range from the 50th percentile to the 94th percentile. According to the evaluation scale the course ranked from average to the upper ten percent of excellence in comparison with other courses evaluated by this instrument.

Between semesters, the experimental group rating indicated more variation in attitudes than did the control group. The highest attitude rating (94%) was given by the first semester (1966/67) experimental group, and this score was in the top ten percent of the evaluation scale. Variations in these ratings can probably be contributed to sampling error.

The author developed a questionnaire which was given to each student in the experimental group. Appendix E contains the questionnaire and its tabulated results. This student attitude questionnaire can be summarized by stating that twenty-nine of the thirty-two experimental students enjoyed taking the course on the PLATO Teaching System. The other three students either did not enjoy this method of instruction, or were undecided about their attitude. Nineteen students preferred programed instruction to the classroom instruction. Eight of the students who marked "undecided" commented that it depended on the course. Five students who marked "no" stated that they missed the personal contact with students. Seventeen students stated they would prefer to have teaching machines for part of the course, while eleven would prefer teaching machines used for the whole course. Two students preferred not to have teaching machines used at all, and the same number did not care whether machines were used or not.

Twenty-one of the thirty-two experimental students indicated that they learned with less effort on the computer-based instruction because the material is well-organized and they could learn at their own speed. Six students did not agree with this point and five were undecided.

Twenty-five students indicated that the machine itself was not an obstacle to learning, while seven students indicated that the machine was an obstacle to learning. These seven students were referring to the times when mechanical failures were encountered. Although these mechanical difficulties were few, it was rather disturbing to some of the students when such incidents occurred.

In regard to the subject content covered, twenty-five students stated that the steps in the learning sequence were just right. One student felt the learning sequence was not simple enough, while six students felt the learning sequence was too simple. No one felt that the subject matter was too difficult.

When asked if the machine ever became monotonous, five students stated "yes" and indicated that the monotony set in after about three-fourths of the way through the program. Twenty-five students indicated that working with the machine never became monotonous. Two students were undecided.

The majority of the students felt that they learned much more, or somewhat more, on the machine than by studying the textbooks. The results of this questionnaire indicated that students had various opinions, but the majority revealed a favorable reaction towards computer-based instruction.

The experimental students had the opportunity to express their likes and dislikes for computer-based instruction and the program by pressing the "comment" button and typing in a comment. Some of the comments in favor were:

> The machine helped a great deal in making the course a more exciting and interesting course.
>
> I have been more than satisified with the over-all learning experience and mastery of material covered.
>
> The course was lots more interesting than I first thought it would be. I think the machines are an excellent educational device.
>
> I believe computer-based instruction makes learning much easier.
>
> The material was covered very thoroughly and I learned a great deal more than in a regular class.
>
> I found this a quick way to learn this material.
>
> These lessons have been helpful to me. I am now able to find information which I never knew existed.
>
> The entire course proved to be very beneficial to me in my other subjects.

Some of the comments against were:

> The course lacks the liveliness that exists in a conventional type of teaching.
>
> It is a waste of time to wait 10 to 15 minutes for students to finish a unit before we can progress to the next unit.
>
> The one drawback which I have found in this type of learning is that I miss the discussion of the material. I feel that without the discussion session or seminar much is lost.
>
> I wish I was a better typist.
>
> The tapping of the typewriters in this room is very annoying.

In general the experimental group was favorably impressed with the efficiency with which they learned in terms of (1) ease, and (2) use of time.

The unfavorable comments were in regard to (1) lack of class discussion on the material, (2) administrative difficulties (such as delay in starting new units), and (3) external distractions (such as noisy typewriters).

CHAPTER VIII

DISCUSSION OF RESULTS AND IMPLICATIONS; CONCLUSIONS

Reviewing briefly, the purpose of this study was to compare computer-based instruction with the conventional lecture method as means of teaching the use of the library to undergraduates. The students who participated in this three semester experiment were undergraduates enrolled in Library Science 195--Introduction to the Use of the Library at the University of Illinois. Students were assigned to either the control or experimental groups according to the Library Science 195 section in which they had enrolled. The means over the entire experiment indicated that both the control and experimental groups were matched according to their grade point average and previous knowledge of library use.

On the basis of the statistical evidence obtained the original hypothesis is verified: Undergraduate students learned as well through programed instruction as they did through conventional lecture method. The principal statistical tool used in the analysis was a 2 x 2 repeated measures analysis of variance design with the groups, control and experimental, and the test, pretest and posttest, as main effects. In interpreting the results notice should be taken of the small sample size.

Both treatments indicated a significant gain in library use. This fact is important because it gave evidence that both procedures were working effectively, and also that undergraduates can learn from both procedures based on the gains from the pretest to the posttest.

The author found that the two methods were equally effective in teaching the use of the library to undergraduates. This result seems reasonable to the author because the two treatments taught the same material. Since students from both groups made significant gains, both procedures seem equally suitable for teaching undergraduates how to use the library.

The experimental group took less time because they were not bound by the administrative annoyances associated with the lecture method, e.g., taking attendance and stopping the entire class to make a point for an individual. In the experimental treatment everyone was allowed to work at his own rate, and no one was distracted by his classmates' difficulties in understanding the material. These differences in time use were reflected in the rate of learning for the respective groups.

Because both groups learned the same concepts, used same textbooks, and were given the same library assignments, no difference in the homework preparation time was expected or observed. For both groups, the mean homework preparation time was little more than an hour for each class hour of instruction.

Students' gain in knowledge in the use of the library did not appear to be linearly related to G.P.A. as one might expect. While it was not the purpose of this study to investigate the relationship between gain and past performance (G.P.A.) a few hypotheses can be suggested: (1) The absence of a linear relationship may simply be due to sampling error; (2) Instruction by PLATO may be sufficiently different from the conventional method as to require different learning skills; (3) Since the experimental group had no previous exposure to tutorial logic, their performances may be a function of the novelty of the experimental teaching situation different from a conventional teaching method.

The degree to which a PLATO lesson had to be structured is much greater than for a conventional lecture method. Hence the amount of time required for initial preparation by the instructor far exceeded the amount of time required for the conventional lectures. Subsequent usage of PLATO required much less preparation than the conventional lesson preparation because once the program is written, it can be repeatedly used and revisions can be made without changes in the basic program. Over a period of semesters the total amount of time required in the preparation of PLATO material is appreciatively less than the total amount of time required to prepare conventional lectures.

Since the instructor does not need to be present when PLATO is used, the amount of instructor's time necessary for the administration of the conventional lecture method far exceeds the amount of instructor's time required for the administration of the PLATO method.

From the viewpoint of the author, one of the important realizations confirmed was that much time was required to plan, write, enter, revise, and test the fourteen units in the library use program.

Although it was not necessary to be acquainted with the mechanical details of the teaching system, this familiarity helped the author to deal more easily with the capabilities, or possible capabilities, of the PLATO Teaching System. In this way, the author was able to capitalize on the flexibility of the system while writing the various units.

At no time were there any limitations as to how the material should be presented. New procedures suggested by the author were readily incorporated into the system without difficulty. In fact, extensive variation in the preparation of units was encouraged. The only restriction was the amount of printed material which could be put in a frame, since all printed materials had to fit within the size of the tv display screen. This limitation caused no problem in the preparation of frames, because any number of sequential frames or slides could be used to present or develop an idea.

In writing the frames there was a definite need to anticipate possible questions or problems which the students might encounter while working independently on the material. These problems were the ones which were eliminated in the initial writing before any frames were photographed for machine use. Fortunately, in this program only a few frames needed to be revised, as most of them seemed to be clear and easy to comprehend.

The computer required that the student's answer match exactly with the machine's correct answer or answers. Occasionally it was found that a student gave a correct answer which was not recorded in the computer. When this situation was discovered, the new answer had to be added to the already recorded ones which did not represent as many variations of possible correct answers. This problem could easily have been solved if multiple choice or true and false questions only had been used But the author wanted to make the program interesting and one way this was accomplished was to vary the form of questions.

It was disappointing to the author that the students did not use the "help" sequence as much as the author intended. It is possible the students felt that much use of this key would indicate to the instructor that they were not proceeding very well with the lesson. The "help" sequence was very carefully explained to the students at the beginning of the program, and the author frequently encouraged students to press the "help" key when it was needed. The machine provided for two other alternatives to get at the answer. One way was to ask for the answer by pressing the "answer" key; a second method was to press the "reverse" key and reread the material until the correct answer was found.

In comparing the lecture method and program instruction, the writer feels that both methods of presentation have advantages. It is true that a computer-based teaching system such as PLATO has flexibility. But when it comes to changing or injecting new material at a moment's notice, it certainly can be done more easily in a lecture than on a computerized teaching system. Revisions, additions, and deletions can be done on PLATO or other similar systems, but corrections take more time and labor on such machines. As for the immediate questions which arise in the classroom, the lecture method can handle them more readily than a prescribed program on a teaching system.

The one big advantage for computerized instruction which this study demonstrated is that once the program is prepared, it can be used repeatedly. Any additions, corrections, or deletions can be done without disturbing the basic program sequences.

In this experiment greater gains for the experimental group were anticipated than were indicated in this study. A first reaction was that the data was disappointing, since the author had put so much effort into the program material. The author came to realize, however, that her lectures had improved also as the result of writing the machine program. The probable basis for this anticipation in gain for the experimental group was that the author was able to observe each student on the machine more closely than those students in the lecture group. These observations revealed that the experimental group was progressing, on the whole, quickly through the program and seemingly were transferring the knowledge received on the program to their library problems. The author found no differences in the homework assignments completed by both groups. It was gratifying to the author to discover that the experimental group made as much gain as the control group and did it in less time.

This study has demonstrated that it is possible to teach an introductory course on the use of the library by using PLATO System. It would be interesting to adapt the same content material to another kind of teaching logic to determine which is the most effective. The teaching logic which the author has in mind is the "inquiry" method, which employs a problem solving technique. In this logic, the student is presented with a series of problems from which he chooses a problem to solve. The problem is answered by obtaining information available in the program either from series of reference slides or frames which have been developed for each problem or from calculations which the student may request from the computer. The student has the complete freedom to choose his problem solving strategy from the information provided. Like the tutorial logic, each question would be judged as correct or incorrect. A combination of the tutorial and inquiry teaching logic could also be explored as means of teaching the use of the library to undergraduates.

Based on this study, the following conclusions have been drawn:

1. Students under both treatments made significant gains in their knowledge of library use.

2. The experimental and control groups did not differ significantly in the amount of knowledge gained as a result of their respective treatments.

3. It was seen that in class the experimental group covered the same amount of material in less time than the control group; the rate of gain in knowledge of library use was significantly higher for experimental than control group.

4. For the experimental group, no significant linear relationship was seen between the amount of time spent in class and the gain in knowledge of library use.

5. Both groups spent a little more than one hour in preparation for each hour on instruction.

6. The experimental and control groups did not differ significantly in terms of their rates of gain in knowledge of library use per hour of homework.

7. No significant linear relationship was seen between grade point average and gain in knowledge of library use.

8. Much more time was required for the initial preparation of PLATO lessons than for the initial preparation of the conventional lectures.

9. Subsequent preparations for PLATO lessons required much less time than subsequent conventional lecture preparations.

10. PLATO instruction required less teaching assistance then conventional lectures.

11. Instructor's time during administration of lectures far exceeded the amount needed for the administration of the PLATO method.

Since PLATO can be used in teaching knowledge of the library, it would be interesting to apply this teaching method to other areas of library education. It seems reasonable to assume that this teaching procedure could work in the area of cataloging or other "core" courses where basic facts are stressed.

The experiment described in this study could be repeated using a larger sample of students, randomly selected, to further verify these results. If a larger group were used, one section might use the tutorial logic and the other an inquiry logic to determine if either form has greater advantages.

It should be useful for future teaching to develop several programs using different logics to obtain experimental data as to the best approach for such a modern teaching system as PLATO. Variations in the programing design and technique should provide a number of relevant experimental designs applicable to several areas in library science.

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APPENDICES

PLATO hand form for SELECTRIC TYPEWRITER

Slide No. 1

UNIT XIII

Indexes

The word "index" comes from the Latin word "indicare" which means to point out. Thus an index does not provide the information which is sought, but it indicates where it can be found.

Previous lessons have mentioned two kinds of indexes, an index found in a book and the card catalog which is the index to the material in the library.

To proceed, push cont.

APPENDIX B

THE FIRST TEN FRAMES
OF UNIT #13 ON INDEXES

1

Unit XIII

Indexes

The word "index" comes from the Latin word "indicare" which means to point out. Thus an index does not provide the information which is sought, but it indicates where it can be found.

Previous lessons have mentioned two kinds of indexes, an index found in a book and the card catalog which is the index to the material in the library.

To proceed, push Cont.

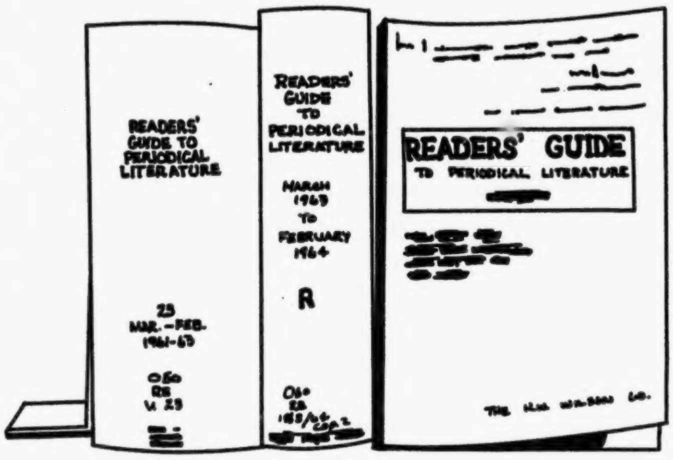
2

There are three other kinds of indexes you will need to know about in seeking material on a particular subject.

1. Indexes to literature appearing in periodicals.
2. Indexes to material appearing in newspapers.
3. Indexes to literature appearing in collections.

First, let us turn our attention to indexes appearing in periodicals.

The most general index is the READERS' GUIDE TO PERIODICAL LITERATURE.


READERS' GUIDE TO PERIODICAL LITERATURE
23
MAR.-FEB.
1961-63
050
R2
V. 23
READERS' GUIDE TO PERIODICAL LITERATURE
MARCH 1963 TO FEBRUARY 1964
R
050
R2
1963/64
cop. 2
READERS' GUIDE TO PERIODICAL LITERATURE

4

The Readers' Guide to Periodical Literature is an author and subject index to more than 100 well-known general periodicals or magazines, such as Life, National Geographic.

It is published twice a month, each issue reporting articles that appeared about two or four weeks previously. From time to time the entries from the separate issues are combined into single volumes covering periods of several months, a full year, or a two-year interval.

At the beginning of each volume of the Readers' Guide, there is a list of the periodicals it indexes, with the abbreviations used to stand for each name.

5

READERS' GUIDE TO PERIODICAL LITERATURE
Abbreviations of Periodicals Indexed

ALA Bul—ALA Bulletin
Am Artist—American Artist
Am City—American City
Am For—American Forests
Am Heritage—American Heritage
Am Hist R—American Historical Review
Am Home—American Home
Am Rec G—American Record Guide
McCalls—McCall's
Miss & Roc—Missiles & Rockets
Mlle—Mademoiselle
Mo Labor R—Monthly Labor Review
Mod Phot—Modern Photography
Motor B—Motor Boating
Motor T—Motor Trend
Mus Am—Musical American

From the illustration above, what periodical does the abbreviaton Am Hist R stand for?

What is the abbreviation for Monthly Labor Review?
Study abbreviations before proceeding.

6

Also in the front of each volume there is a Key to Abbreviations.

+	continued on later pages of same issue
abp	archbishop
abr	abridged
Ag	August
Ap	April
arch	architect
arr	arranged
assn	association
bart	baronet
bibliog	bibliography
bibliog f	bibliographical footnotes
bi-m	bimonthly
bi-w	biweekly
bp	bishop
comp	compiled, -er
cond	condensed
cont	continued
D	December
ed	edited, -ion, -or
F	February
Hon	Honorable
il	illustrated, -ions, -or
inc	incorporated
introd	introduction, -tory
Ja	January
Je	June
Jl	July
jr	junior
m	monthly
Mr	March
My	May
N	November
no	number
ns	new series
O	October
por	portrait
prelim p	preliminary paging
pseud	pseudonym
q	quarterly
rev	revised
S	September
semi-m	semimonthly
sr	senior
sup	supplement
tr	translated, -ion, -or
v	volume
w	weekly

What do the following abbreviations stand for?

v		Je		por	
w		Mr		m	

Get acquainted with the abbreviations and their meanings before proceeding.

You have now studied the abbreviations on the previous two slides. See how many of the following abbreviations you can correctly answer. All answers must be correct before proceeding. If in difficulty restudy the previous two slides.

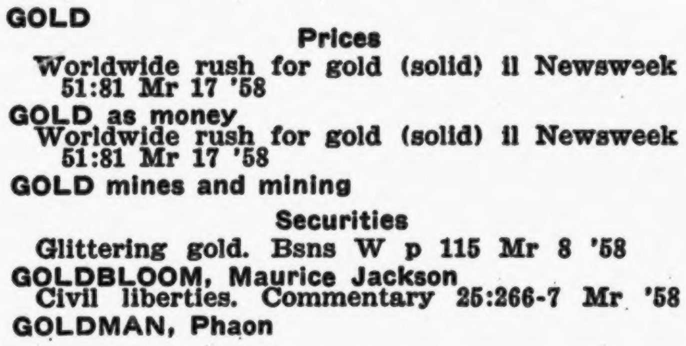
Am Hist R
Mus Am
O
biblio
J1
N

Good for you if you answered them all correctly! You may proceed.

8

The periodical articles listed according to author are called author entries. Those listed by subject are called subject entries.

The author and subject entries are arranged in a single alphabetical listing. Thus an entry for the subject GOLD is followed by an entry for an author named GOLDBLOOM.



GOLD

Prices

Worldwide rush for gold (solid) il Newsweek 51:81 Mr 17 '58

GOLD as money

Worldwide rush for gold (solid) il Newsweek 51:81 Mr 17 '58

GOLD mines and mining

Securities

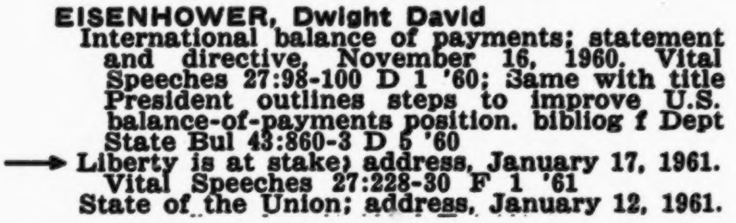
Glittering gold. Bsns W p 115 Mr 8 '58

GOLDBLOOM, Maurice Jackson

Civil liberties. Commentary 25:266-7 Mr '58

GOLDMAN, Phaon

Sample author entry



EISENHOWER, Dwight David
International balance of payments; statement and directive, November 16, 1960. Vital Speeches 27:98-100 D 1 '60; Same with title President outlines steps to improve U.S. balance-of-payments position. bibliog f Dept State Bul 43:860-3 D 5 '60
→ Liberty is at stake; address, January 17, 1961. Vital Speeches 27:228-30 F 1 '61
State of the Union; address, January 12, 1961.

Explanation

Author of article is Dwight David Eisenhower
Title is Liberty is at stake
Name of periodical - Vital Speeches
Number 27 is the volume number
228-30 are the pages of this article
Date: February 1, 1961

In all author entries, the author is first given.

10

This same article can be found under the following subject entry.

UNITED STATES
National goals for the 1960's. il PTA Mag 55:16-19 F '61

Politics and government
Liberty is at stake; address, January 17, 1961. D. D. Eisenhower. Vital Speeches 27:228-30 F 1 '61

Subject entry is UNITED STATES
Subheading - Politics and government

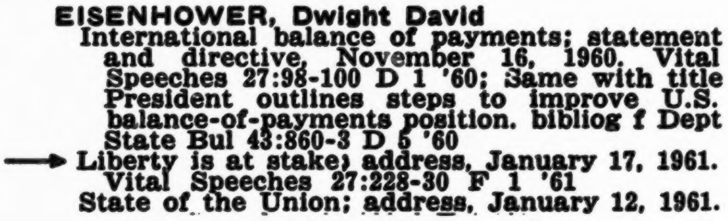
From the previous instructions you should be able to give the following information.

Title of article
Author of article
Name of periodical
Volume Paging
Date (in full)

THE HELP SEQUENCE FRAMES FOR
THE FIRST TEN FRAMES
IN UNIT # 13

h 9

Sample author entry



EISENHOWER, Dwight David
International balance of payments; statement and directive, November 16, 1960. Vital Speeches 27:98-100 D 1 '60; Same with title President outlines steps to improve U.S. balance-of-payments position. bibliog f Dept State Bul 43:860-3 D 5 '60
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State of the Union; address, January 12, 1961.

Explanation

Author of article is Dwight David Eisenhower
Title is Liberty is at stake
Name of periodical - Vital Speeches
Number 27 is the volume number
228-30 are the pages of this article
Date: February 1, 1961

In all author entries, the author is first given.

h_{101}

You need no help. Just read your illustration more carefully.

h107

Reverse to the previous two slides and refer to abbreviations.

APPENDIX C

THE ANSWER SHEET FORM

USE	PAGE	SLIDE	PROBLEM	POSITION	JUDGER	ANSWERS	SPECIAL WRONG ANSWERS	HELP PAGE (S)	SPEC. HELP (S)
M1	1	14	X		X	X	X	X	X
M2	2	15	X		X	X	X	X	X
M3	3	16	X		X	X	X	X	X
M4	4	17	X		X	X	X	X	X
M5	5	18	1		10	American Historical Review	X	101	X
			2		10	Mo Labor R/ Mo. Labor R.	X	101	X
M6	6	19	1		10	Volume	X	101	X
			2		10	Weekly	X	101	X
			3		10	June	X	101	X
			4		10	March	X	101	X
			5		10	portrait	X	101	X
			6		10	monthly	X	101	X
M7	7	20	1		10	American Historical Review	X	107	X
			2		10	Musical American	X	107	X
			3		10	October	X	107	X
			4		10	bibliography	X	107	X
			5		10	July	X	107	X
			6		10	November	X	107	X
M8	8	21	X		X	X	X	X	X
M9	9	22	X		X	X	X	X	X
M10	10	23	1		10	Liberty is at stake	X	9	X
			2		10	D.D. Eisenhower/Dwight D. Eisenhower/Dwight David Eisenhower	X	9	X
			3		10	Vital Speeches	X	9	X
			4		10	27/Twenty seven	X	9	X
			5		10	228-30/228-230	X	9	X
			6		10	February 1, 1961/ Feb. 1, 1961	X	9	X

APPENDIX D

SAMPLE OF LIBRARY PROBLEM WORKSHEET

UNIVERSITY OF ILLINOIS

GRADUATE SCHOOL OF LIBRARY SCIENCE

Lib. Sci. 195 Introduction to use of the library
Miss Axeen

PERIODICAL PROBLEMS

DIRECTIONS: Using the periodical indexes listed on the attached sheet, answer the following questions. You will find all these indexes in the Reference Room of the library. PLEASE TYPE YOUR ANSWERS.

A. Identify periodical with the index.

1. Articles in such periodicals as

   American Association of University Professors
   American Sociological Review
   Harvard Business Review
   Library Trends
   Survey of Current Business

   are indexed in ______________________________

2. Articles in such periodicals as

   Publisher's Weekly
   Science News Letter
   Vital Speeches of the Day
   Fortune

   are indexed in ______________________________

3. Articles in such periodicals as

   Audiovisual Instruction
   College English
   Child Development
   Minnesota Journal of Education

   are indexed in ______________________________

4. Articles in such periodicals as

   Horn Book
   New York Times Book Review
   Harper's Magazine
   New England Quarterly

   are indexed in ______________________________

5. Articles in such periodicals as

Engineering Journal
Electronics
Journal of Applied Chemistry
Modern Plastics

are indexed in ________________________________

B. Indicate the periodical index you would consult first for the following topics. Briefly give your reasons for your choice.

1. Several reviews of a novel.

2. The use of teaching machines in colleges and universities.

3. Latest information on electronic data processing.

4. Latest legislation on civil rights.

5. Reproduction of Raoul Dufy's "Regatta".

C. Identify each item in the following entries.

The following is an entry from the Reader's Guide--March, 1963 - February, 1964.

EXAMPLE: Continental airlines
Trans World, Continental
discuss merger. L.L. Doty.
Aviation W 79:34-5 0 28 '63.

Continental airlines--Subject entry; Trans World, Continental discuss merger--title; L.L. Doty--Author of article; Aviation Week--Title of periodical; 79--volume; 34-35 pages; October 28, 1963--the date of article.

The following is an entry from Book Review Digest--1963.

1. GRIFFIN, GWYN. A significant experience. 91p
   $3 Holt.
   Reviewed by Edward Weeks
   Atlantic 212:150 O '63 370w

2. The following entry is from PAIS Volume 50--October, 1963-September, 1964.

   Bur. nat. affairs. The Civil Rights Act of 1964; what it means to employers, businessmen, unions, employees, minority groups; text, analysis, legislative history. '64 vii + 424 p tables $9.50; pa $8.50 LC 64-25380

3. Entry from Education Index Volume 14--July, 1963-June, 1964.

   ATHLETIC clubs

   Grinnell college Faculty kinds club. K. Elliott. il J Health Phys Ed Rec 34:73 S'63.

4. Entry from Art Index Volume 13--November, 1961-October, 1963.

   MAZZA, Giuseppe, 1563-1741

   Reproductions
   David and Goliath
   Connoisseur 148: 206-15 N'61.

-4- Periodical Problem

Entry from Applied Science & Technology Index 1963.

AIR conditioning equipment

Design
Air conditioning and architecture; design
parameters. S.J. Greenleaf. flow diags
Prog. Arch 44:152-5 O'63.

C. Using the rotary kardex in the Reference Room, find the call number and the location of the following periodicals.

EXAMPLE: Life, Volume 20, February 21, 1956.

051
LIF   Reference, Architecture, Undergraduate

1. Connoisseur, Volume 148, November, 1961.

2. Aviation Week, Volume 79, October 28, 1963.

3. Journal of Health, Physical Education, and Recreation, Volume 34, September, 1963.

4. Progressive Architecture, Volume 44, October, 1963.

5. Asian Bibliography--latest copy.

APPENDIX E

RESULTS OF STUDENT ATTITUDE QUESTIONNAIRE FOR STUDENTS USING THE PLATO TEACHING SYSTEM

RESULTS OF STUDENT ATTITUDE QUESTIONNAIRE

1. Have you enjoyed taking this course by machine?

   29 yes

   2 no

   1 undecided

2. Do you prefer programed instruction to the conventional classroom instruction?

   19 yes

   5 no

   8 undecided

3. If you were to take another course would you

   11 prefer to have teaching machines used for the whole course?

   17 prefer to have teaching machines used for part of a course?

   2 prefer not to have teaching machine used?

   2 not care whether teaching machines were used or not?

4. Do you feel that you have learned with less effort by programed instruction than by the conventional classroom instruction?

   21 yes

   6 no

   5 undecided

5. Did you find that the machine itself was an obstacle to learning?

   7 yes

   25 no

   0 undecided

6. With regard to the subject matter covered were the steps

6 too simple

25 just right

1 not simple enough

0 too difficult

7. Did working with the machine become monotonous?

5 yes

25 no

2 undecided

8. Comparing the work done on the machine with studying the textbooks, do you feel that you learned

18 much more on the machine

10 somewhat more on the machine

4 there was no difference